CLEAN AIR

SUMMER 1976
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John Graham Pollitt

Industrial News

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P. G. Sharp

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CLEAN AIR

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Diary of Events

21st July (Wednesday)
a.m. Technical Committee Meeting.
London

p.m. Parliamentary & Local Government Committee Meeting.

28th July (Wednesday)
p.m. Meeting of the Council of the Society.
London

27-30th September
Environmental Health Congress.
Harrogate

4th October (Monday)
a.m. London, South East & Central Southern Division Open Meeting.
The Guildhall, London

11-15th October
43rd Clean Air Conference, Edinburgh.

3rd November (Wednesday)
a.m. Parliamentary & Local Government Committee Meeting.
p.m. Technical Committee Meeting.
London.

10th November (Wednesday)
a.m. Conference & Publicity Committee Meeting.
p.m. General Purposes & Finance Committee Meeting.
London.

25th November (Thursday)
p.m. Meeting of the Council of the Society.
London.

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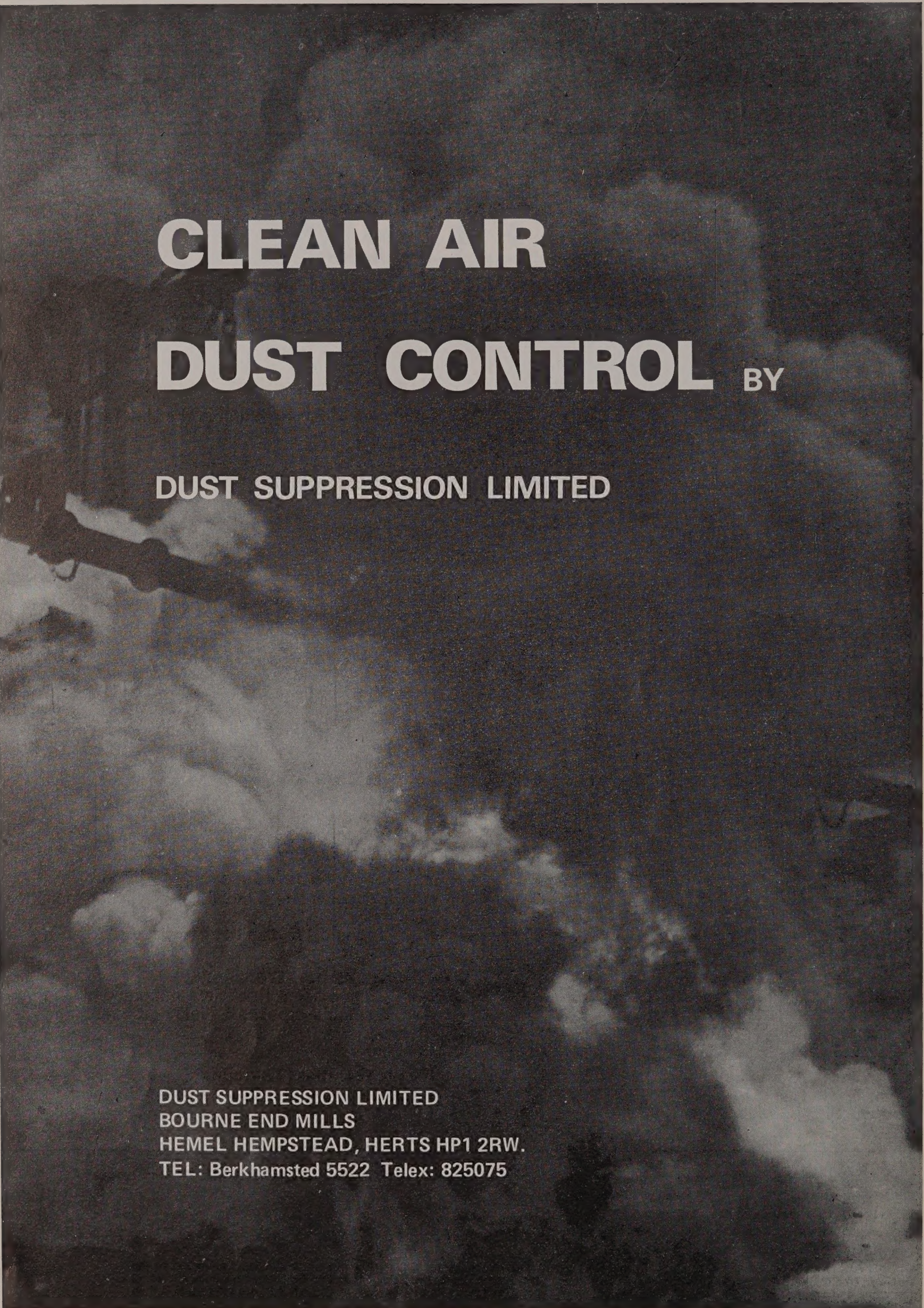

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CLEAN AIR

Whither Smoke Control?

It is now 1976, twenty years since the 1956 Clean Air Act reached the Statute Book; and on another page of this journal we have to report that in the quarter ending 31st March 1976 no smoke control orders came into operation in England, Wales or Scotland. It would be nice to be able to say that this was because, twenty years after the passing of the Act, everywhere in the country was subject to smoke control. But unfortunately we know that this is not so; only about 60% of the premises in this country are subject to smoke control, and in the last two years, because of the economic climate and the confusion caused by government circulars on Rate Support Grants which gave the impression that smoke control might be considered of little importance, progress has been severely cut back. Some authorities regarded the government circulars as a mandate for slowing down their smoke control programme; more regrettably some others regarded this as a mandate for stopping their programmes altogether—in some instances by authorities which were on the verge of becoming completely smokeless. Progress has been halted, surveys have become out of date, and the cost of re-starting programmes will be immense. Twenty years, and the job is still not done.

It is true that there are many premises in the country which are in fact subject to smoke control which do not figure in any statistics because they are not in an officially designated smoke control area. But even so, only some 60% of premises in this country are covered. Although smoke in our atmosphere overall has been reduced from 2·29 m. tonnes in 1956 to 0·40 m. tonnes in 1975, 87½% of that smoke still comes from domestic premises. Local Government re-organisation has meant changes in the approach to smoke control and the abolition of the distinction between the former 'black' and 'white' areas has also made a difference. It is now the responsibility of the individual local authority to decide how much smoke control is needed within its area. Local authorities may, of course, seek advice from Warren Spring Laboratory and from the Department of the Environment; but it seems only too clear that in some instances local authorities have decided that they do not need any more smoke control, and in others, where there is as yet no smoke control, they have decided that they do not need it.

Such authorities may be in for a rude awakening. The EEC have recently issued proposals about Directives entitled 'Council Resolution concerning the determination of criteria for Sulphur Dioxide and Suspended Particulate Matter in urban atmospheres' and 'Council Directive concerning health protection standards for Sulphur Dioxide and Suspended Particulate Matter in urban atmospheres'. Discussion is already going on about these proposed Directives, but it is generally felt throughout the country that they should be accepted, albeit in a modified form Undoubtedly, there will be further discussion and argument about actual figures and standards to be laid down, and indeed, the Society having been asked to do so, has already made suggestions on these very points to the appropriate committee at the House of Lords. The standards suggested are based on the well established and accepted document WHO 506, to which our President, Professor P. J. Lawther made no small contribution. Whether or not these suggestions will be accepted either in whole or in part remains to be seen, but what is clear is that whatever figures and standards are ultimately accepted, it seems many areas in this country will fall far below such standards. The National Survey shows that if the standards were set at 250 micrograms per cubic metre (daily concentration, 24-hour period), not to be exceeded for more than 7 days in any year, of which not more than three days may be consecutive—a figure which the Society considers reasonable, then the smoke levels in seventeen towns in this country would be unacceptable. And if the EEC Directive is adopted, then it will be incumbent upon the member nations of the Community to enact legislation to enforce it.

So, although it may have seemed to some people that smoke control was virtually a thing of the past with which we need no longer concern ourselves, it is indeed very much a matter for the present. Those authorities which have felt that they have little further to do—or indeed nothing at all to do—would be well advised to review the position again.

At present there are grants to householders from central government and from local authorities; it is because of such grants that it is often argued that more smoke control cannot be afforded. But a point that should be remembered is that it is unlikely that government or local authorities will go on paying grants for ever. Sooner or later it seems likely that it will be decided that no grants will be payable beyond a certain date. So there is considerable merit in completing smoke control programmes as soon as possible. When the EEC Directive becomes law in this country, as it surely will, then the authorities concerned will have to take the necessary steps to reduce the smoke levels—with or without a grant. Why not do it now?

National and International Factors Influencing Changes in the Policy of Air Pollution Control

by

P.G. Sharp

The Keynote Address at the International Clean Air Conference in Pretoria, South Africa 26th-29th April, 1976

This paper is published in 'Clean Air' with the kind permission of the Organising Committee of the Conference

It used to be said of Prussia in Bismarck's time that everything was forbidden unless it was compulsory. Today we hear that in the Netherlands everything is permitted, even that which is forbidden. And in Britain we live in a permissive society and yet more and more legislation is being enacted and reaching the Statute Book. Whether all such legislation is enforced or even enforceable is another matter. These cynical examples of national characteristics usually emanate from the country concerned; and this could point to a fortunate international characteristic. All nations possess a sense of humour—which is indeed fortunate, because in such humour is more than a grain of truth.

Much existing legislation had its origin in classical times and much law today is still based on the old Roman law. But the way in which different countries have adopted and adapted this basic law varies considerably because of different national characteristics, differing requirements and differing attitudes. Some nations seem to be more law abiding than others; others give the impression of being less amenable to discipline. Consequently, over the years, different approaches have been evolved by different nations. It is generally accepted, for example, that the northern races tend to be rather stolid whereas those peoples who live in warmer and sunnier climes tend to be more volatile. So climate, too, may be said to have an effect in that it has helped to mould and develop certain national characteristics.

Obviously, there are many different approaches to the development of legislation and legal systems but generally it may be said that these fall into two main classes: legislative systems which have developed rather haphazardly with legislation enacted as and when required, and the other, legislative systems which have followed a more logical development and have been codified. Because one or other of these systems have been used by nations which, in the past, had imperial and colonial ambitions, the two systems were spread all over the world and former colonies and dependencies, on achieving independence, have often adopted or adapted the system which they inherited. Even if they rejected outright the old system, the system they adopt is still likely to fall into one of these two main classes.

Perhaps the classic example of haphazard development is that which pertains to Great Britain. First, in Britain there is no written constitution and much of the legislative system is based on common law—i.e. case law. Legislation as such has been enacted in the past because it was thought to be a good thing, because it was capable of enforcement and because it could achieve the desired results. It was therefore more or less readily accepted by the people. There are instances of legislation being deliberately delayed until it became clear that enforcement was possible and the legislation acceptable. On the other hand, and more especially in recent times, there has been a change; some legislation has reached the Statute Book, but has not yet been implemented. Later, when we consider clean air legislation in rather more detail we will see examples of both these cases.

A typical example of codified legislation is that of France, and the Code Napoleon. This is a logical system and a system which, like the British, has spread all over the world. In some places, for example, Canada and the United States, the two systems have met and sometimes clashed. The result has not always been that one system has triumphed and the other been rejected, for sometimes a new system based on the best of both the old ones—though not always—has emerged. In some instances, the two systems have continued to operate in parallel in different regions of the same country. Here, in South Africa, we have a somewhat different, though at the same time similar, example. Here two imported cultures have affected the country's development, and its legislation. But, whatever legal system any particular country or nation adopts, there is one form of legislation which is common to all. This may be termed 'political', or perhaps more unkindly, 'panic' legislation. Often, for sound political motives and with the best will in the world, governments have enacted legislation but have taken no real regard of its consequences or methods of enforcement with the result that the law has fallen into disrepute. Those working in the realms of the environment and the control of air pollution are no strangers to such legislation.

A further factor is that of federal and regional government. In the U.S.A. for example, there is Federal legislation which applies to the whole country; but this does not prevent the constituent states from enacting and implementing their own legislation which in some instances goes much further than that required by the Federal Government. Similarly, in West Germany the various regions of the Federation are in a position to enact their own legislation. Both are examples of regions imposing further legislation on that imposed by central government.

The European Community, on the other hand, is now beginning to work the other way. Here we have nine countries each with its own system of legislation—a haphazard system in Britain, a codified system in France and a regional system in West Germany for example—now having directives imposed on them by a central commission. 'Union' legislation is being superimposed on national legislation and the stage is being set for an acute difference of opinion, or even a clash between national and international interests.

This, the first mention of the E.E.C., which is a form of internationalism, leads somewhat naturally into a brief consideration of another important factor which is both national and international in its character and influence. This is the economic factor. This can be applied, both internationally and nationally in many different ways. Purists might argue that so far as air pollution is concerned, it should be disregarded; that the cost of the control or abatement of air pollution should not be a factor which should be considered. Many others would not go as far as this but would agree that where human health is concerned, then the economic factor should not be taken into account; it should, however, be given full weight when the control of air pollution is necessary as a means of improving amenity. Even if agreement can be reached on this and on what levels of air pollution are likely to affect human health, there is still plenty of room for disagreement on the application of the economic factor. Different standards of control for plants in different countries making the same product by the same process mean different costs and so different prices. Can such things be allowed in a so-called Common Market? Or must the same controls, irrespective of other factors, be imposed on all? Should the nation or country that has climatic and geographical advantages be allowed to exploit them?

A number of politicians all over the world have been expounding the policy of the 'polluter pays'; but none of them has stated categorically who is the polluter. The general public tend to assume that industry is the polluter and it has been rather naively assumed that industry should therefore pay. Little consideration has been given to the fact that if industry is made to pay, whether it be by the cost of installation of expensive control equipment or in the payment of taxes or fines, this cost will be reflected in the price of the product and so borne by the consumers—the general public. The payment of fines for polluting the atmosphere raises another bone of contention. Most countries do impose fines of varying severity for breaking the law and exceeding laid down limits of emission. Other nations, adopting the principle that the polluter should be made to pay, use a fiscal policy whereby different levels of taxation are imposed depending on the amount of pollutants emitted. In Norway, for example, in 1971 a tax was introduced on the sulphur content of oil based fuels. This form of taxation, therefore, really amounts to an indirect charge on sulphur dioxide emissions into the atmosphere—i.e., emissions from furnaces using oil as a fuel. There is no tax on the SO_2 emitted from other processes such as sulphuric acid plants, paper pulp mills or steel works; nevertheless the tax could be said to apply to about two thirds of the total emissions of SO_2. The tax charges are low and, so far, their incentive effect has not been really very noticeable. Similarly, in the Netherlands, charges are levied on the sulphur content of all fuels. Again the charges are very low but money collected from this source is used to finance the costs of implementing the Air Pollution Act and the administrative costs of pollution control. It may be claimed that these methods are each in their own way, successful; but objections are often raised to the latter method on the grounds that this policy can be interpreted as a licence to pollute.

So far, the factors considered have all been man-made. They are therefore capable of change and modification; and although they certainly apply to the legislation of air pollution control they also apply to other forms of legislation as well. But in considering the legislation dealing with air pollution control, there are other factors which, perhaps, cannot be changed so easily. These are the natural factors of geography, climate and meteorology.

The geographical position of a country and its geographical and topographical features can be an advantage or a disadvantage as far as air pollution control measures are concerned. This is obviously a subject on its own and it is only possible here to mention one or two simple examples. Britain is an island situated in a prevailing south westerly air stream which means not only that it receives little pollution from elsewhere but also prevailing winds help to disperse pollutants; and until recently it has generally been accepted that a policy of dispersion of pollutants through high stacks has been to its advantage. However, Britain is now being accused by Scandinavian countries of invisible exports of sulphur in various forms, for air, be it clean or polluted, knows no boundaries. And the wind does not always blow from the sou' west; sometimes it comes from the east, and higher levels of SO_2 have been recorded in Kent and East Anglia and their SO_2 has presumably come from the Continent. So Britain may not be in the advantageous position as formerly supposed. Nevertheless, being an island does have its advantages when compared with countries like Luxembourg and Austria which have no sea board and where polluted air has an easy passage from one country to another. Obviously, the advantages and disadvantages of geography and geographical position raise problems which cannot be ignored.

Similarly, climate and prevailing weather are important considerations. People who live in cold countries need to keep warm and therefore burn more fuel for domestic heating than the people who live in warmer countries. More fuel burned means more pollution to be controlled. So, from this point of view, the countries which enjoy a warmer climate all the year round may be said to be at some advantage. On the other hand, countries in the temperate and colder parts of the world are often more windswept and this helps with dispersion of pollutants. Some of the hotter countries are apt to suffer from prolonged inversions which can prove a distinct disadvantage. It is common knowledge that the climate of Los Angeles has contributed very considerably to the problem of photochemical smog, a problem which has not yet become really evident in Europe. So, climate, like geography, has advantages and disadvantages, and can be the cause, as for example in California, of particular —and in this case Draconian legislation.

In the last paragraph, for the first time in this paper the word 'fuel' has been used. The indigenous supplies of fuel in a country obviously constitute another natural factor which must be taken into account. This factor, again, like the economic factor is both national and international in its implications. Those countries which have access to an adequate supply of natural gas are at an advantage compared with those who have no such supply. Those countries which have easy access to hard coal are at an advantage compared with those countries who have to rely on soft coal. Oil virtually constitutes a factor on its own. Although its origins may be national, its use is international and its price and availability have, and will have in the future, a deep and lasting influence on the use of fuel generally, the development of new forms of energy and therefore on clean air legislation throughout the world.

If we now turn more specifically to clean air legislation in the light of the factors mentioned, it will be seen that there is a tendency for this to follow the national pattern of the legislative system of the country concerned. In all, some thirty four countries, thirty in the Northern Hemisphere—mostly between the latitudes of 30° North and 60° North, and four in the Southern Hemisphere, have air pollution control legislation.

Most clean air legislation is comparatively recent but some does go back a very long way. Perhaps the edict of 1273 when the use of coal was prohibited in the City of London as being ' Prejudicial to Health ', and the Royal Proclamation of 1306 which prohibited artificers from using sea coal in their furnaces represent some of the earliest legislation. Although it is on record that one artificer was executed for breaking the latter law, it is clear that it had little effect in the long run and can be classified as an example of 'political' legislation already discussed. Another example of 'political' legislation dates from 1810 when Napoleon issued a comprehensive proscriptive decree to the effect that 'manufactures which give out an unwholesome or unpleasant odour will not be allowed to be established without the authority of the administration'. The decree then continued with a long list of manufactures, some fourteen pages of them, divided into three classes: those which had to be distant from all private dwellings those which were not to adjoin private dwellings unless they could be carried on without damage or inconvenience to the neighbourhood; and those which might remain without inconvenience near private dwellings. Although this decree was ineffective, it is interesting that over a century later in 1917 these regulations were re-established as a basis for a new law under which four hundred different types of enterprises were classified. The problem was, of course, that with the growth of cities, the activities originally outside the city were encroached upon by such growth.

It is generally accepted that there are two classic approaches to air pollution control: the 'best practicable means' approach and 'air quality management' approach. The first is the British approach to the problem which Lord Ashby has decribed as 'tentative—not to say reluctant—untidy and piecemeal, but refreshingly realistic.'

In May 1862, Parliament at Westminster appointed a select Committee to ' inquire into the injury resulting from noxious vapours evolved in certain manufacturing processes and into the state of the law relating thereto '. In moving the appointment of the Select Committee, Lord Derby made reference to the appalling destruction of vegetation going on for years around the Alkali Works at St Helens, Newcastle and Glasgow. The trouble was caused by hydrochloric acid, called in those days muriatic acid, which the majority of manufacturers, despite the evident damage they were causing, were allowing to escape with impunity. And so, in 1863 the Alkali Act was passed. It applied only to this one industry and only for the control of one pollutant—muriatic acid. The Act was so drafted that it did not inconvenience trade unduly, but it did empower inspectors to have free access to the works and to enforce the condensation of the acid vapours. Although the best practicable means were in fact employed in enforcing this legislation, it was not until 1906 when the Alkali etc. Works Regulation Act, which extended and consolidated previous similar Acts, was passed that the expression was defined as follows: ' The expression ' best practicable means ' where used with respect to the prevention of the escape of noxious and offensive gases, has reference not only to the provision and the efficient maintenance of appliances adequate for preventing such an escape but also to the manner in which such appliances are used and to the proper supervision by the owner of any operation in which such gases are involved '. So by 1906, by means of haphazard and piecemeal legislation, the philosophy of the best practicable means had been established. It has continued as the basic philosophy of all clean air legislation in Great Britain ever since.

The Alkali Act, however, revised as it was, dealt only with emissions from specific plants known as ' Scheduled Premises '. Some attempts were made during the late 19th century to introduce legislation to control smoke from industrial and domestic sources, but these all failed for one reason or another. Smoke was, however, proscribed as a nuisance under the Public Health Act of 1874; but it was not until 1956 following the publication of the Beaver Report in 1954 that the Clean Air Act was passed. This legislation was aimed at controlling industrial smoke and gave local authorities, if they so wished, the powers to control domestic smoke by establishing ' smoke control areas '. It should be noted that there was no compulsion of local authorities to enact this legislation and to this day there are areas in Britain where this legislation does not yet apply. The growth of clean air legislation has continued to be haphazard. It was found after the 1956 Clean Air Act had been in force for some time, that there were loopholes and a further Act was passed in 1968 which attempted to close some of the worst of these. In 1974 the Control of Pollution Act was passed. This contains a section dealing with the control of air pollution; but although this Act is now on the Statute Book, the necessary regulations to secure its implementation have not yet been issued, largely for economic reasons. However, they are now under active consideration, and it is hoped that 1976 will see them brought into force.

The control of pollution from road vehicles has also been rather untidy. Regulations have been issued from time to time under the Road Traffic Acts, the latest, strangely in line with those of the E.E.C., being in 1973.

In 1975, the Alkali Act was repealed and embodied in the Health and Safety at Work Act of 1974. This has virtually meant no change in the actual legislation controlling emissions from the scheduled processes and the Alkali Inspectorate has to a large extent, retained its identity within the Health and Safety at Work Commission; the principle of the best practicable means has been carefully preserved. Now, in January 1976, the Royal Commission on Environmental Pollution has published its Fifth Report, 'Air Pollution Control: An Integrated Approach ', and proposes yet further changes.

As we saw earlier, because of the influence of imperial and colonial powers in earlier times, there has been a tendency for those countries where this influence was previously felt, to follow in some instances, the style of legislation adopted by the original imperial power. This has happened within nations of the British Commonwealth and indeed within some nations which were previously within the Commonwealth but have since left it. The legislation in South Africa, the Atmospheric Pollution Prevention Act of 1965 as amended by the Atmospheric Pollution Prevention Act of 1973, follows very much the British pattern and is based very firmly on the philosophy of the best practicable means. On the other hand, because of the fact that this legislation is later in time and so to a degree has been able to benefit from the mistakes of the past, and also because of the effect of other national cultures, it is very much less haphazard in form than its British counterpart and has the great merit of being compact.

Similarly, we find that in Australia, clean air legislation originally intended to follow the British pattern using the Alkali Act of 1906 and the Clean Air Act of 1956 as bases. Clean air legislation in Australia is mostly by the States and so we obviously find that there are variations. It is interesting that New South Wales enacted a Smoke Abatement Act as early as 1908. However, since then New South Wales, closely followed by Queensland and Western Australia, has enacted legislation very similar to its British counterpart. Victoria, on the other hand, in 1957 enacted a number of provisions of the original British Clean Air Act but did not make any provision for smokeless zones. Since then, Victoria has set up an Environmental Protection Agency and there are signs of a shift to air quality monitoring since that time. The state of South Australia is following a similar pattern. Perhaps it is time for the U.K. to review its own haphazard, piecemeal legislation and to put it in a more logical form—and indeed the Royal Commission referred to earlier has recommended such a course.

The other classic approach to air pollution control is that of air quality management. This was first used by the Soviet Union in 1951 when air quality standards for 10 pollutants were set. Standards were backed up by experiment and direct research on human, animal and plant organisms. The list of pollutants has now been extended to 114 substances. The ambient air quality standards are fixed nationally as the basic concentration units, but there are no national or regional emission standards, and advantage is taken of the ability to set up industries in less polluted areas which are still extensively available in the U.S.S.R.

Taking into account national characteristics, it might be thought that eastern European countries with their own close political ties with the U.S.S.R. would tend to follow a similar pattern of legislation. Although the countries of the eastern bloc do rely on an air quality management approach, their methods of control not only differ from country to country but also differ from those of the Soviet Union. They have retained their own national systems. In Czechoslovakia, for example, air quality standards have been introduced for 18 substances, but there is also a fiscal system of legislation. A basic tax is imposed on fuel consumption or on an assessment of the cost of a necessary control device to reduce emissions. Surcharge taxes are imposed for emissions over certain limits and these also vary with the height of chimney stacks. The highest surcharges are exacted in places such as health resorts; the smallest surcharges are paid in industrial areas. East Germany, although using air quality standards as a basis for control, also has emission standards for dust, sulphur dioxide and other gaseous pollutants. East Germany also uses the air quality inventory as a method of control and this background level has a considerable bearing on acceptable emission levels. Poland has established air quality standards for 15 pollutants and also uses a form of zoning. A lower standard is used in areas like health resorts and places where hospitals and schools are sited; a higher standard is used in less protected areas, including areas of dense population. Similar methods are used in Hungary and Rumania.

Most western European countries, with the exception of Great Britain, which we have already discussed, base their controls on air quality together with emission standards. The air quality standards are based on dose effect criteria not unlike those of the United States of America and the US.S.R. The United States also, of course, use the air quality management approach and, as we have already seen have federal legislation based on standards and limits laid down by the Environment Protection Agency implemented by follow-up state legislation.

Japan, with its very high population densities and high car pollution provides a study of air pollution control entirely on its own. In 1969, legislation for the control of air pollution was introduced and from the beginning both air quality and emission standards were used, although it was not until 1971 that an Environmental Protection Agency was created. At the same time, emission standards were reinforced by some 40%. Generally, the method of air pollution control exercised in Japan is very similar to that of the U.S.A., but it seems that changes in standards, usually to make them more stringent, occur much more frequently. For the control of pollution from motor cars, Japan insists on standards very similar to those imposed in the U.S.

Other countries generally fall in to the two main classes but there are slight variations depending on factors of national prestige, climate, geography and finance or economics. Will these various factors have any influence on other countries? When considering clean air legislation in one's own country and comparing it with that of another, one thinks one can always see something better. The grass is always greener on the other side of the fence. One thinks of places where improvement can be made in one's own system which would fit in very well with national requirements, with the requirements of national economics and which will produce a better answer. But self satisfaction and prejudice are difficult to break down and if a country thinks that it has evolved a system of air pollution control which it likes, then it is unlikely to make sweeping changes even if it makes minor ones.

Nevertheless, changes and sometimes sweeping changes are being suggested if not made. West Europe as we have seen, relies on an air quality management approach; Great Britain, now a member of the E.E.C., confirmed by a recent referendum, relies on the philosophy of the best practicable means. The E.E.C. Commissions in Brussels and Luxembourg are issuing Directives based on air quality criteria in some instances without emission standards. These may be acceptable to a few countries, but are certainly not at present acceptable to all and certainly are completely contrary to the philosophy of the best practicable means. Nevertheless, Great Britain, though still believing in the best practicable means is coming to see that there are things to be said in favour of air quality criteria backed up by realistic emission standards which can themselves be based on the best practicable means philosophy. Last year, the Greater London Council adopted reference levels to be known as the ' Greater London Council Guidelines for Air Quality '. The same authority is considering establishing an emission inventory for Greater London on the lines of what is already being done for some of the larger conurbations in West Germany, the Netherlands, Italy and in the U.S.A., Canada and Japan. What is more significant perhaps is that the report of the Royal Commission on Environmental Pollution, published in January, 1976, while stating quite categorically that Britain should adhere to the philosophy of the best practicable means which take fully into account such factors as geography, climate, meteorology and economics for fixing emission limits, does recommend that the Government should establish air quality guidelines for certain pollutants and that local authorities should use these guidelines in adopting air quality targets. And, in any event, the Alkali Inspectorate already sets standards in the form of "presumptive limits". The Royal Commission also consider that the Government should set up a central inspectorate for all forms of pollution. A move towards an EPA? Perhaps.

What will happen in Europe, especially within the E.E.C., is still a matter of conjecture, but it is to be hoped that it will be realised that air quality criteria based on sound emission standards do have their place. Unfortunately, what is not always clear is whether the air quality criteria already established are criteria which must be adhered to and reached or whether they merely represent objectives which would be ideal and which should be aimed at. There are instances where the latter really holds good although the criteria are quoted as absolute standards. If the said criteria could be used as objectives and the best practicable means used as the means of obtaining them, then real progress could be made on all fronts. There are signs that some people, notably industrialists perhaps understandably, in some countries in Europe would like to see a wider application of this principle, for industry these days, if not international, is often multinational. In America, too, not all those concerned with the administration of air pollution control are in favour of the methods at present adopted; a considerable number of knowledgeable people in high places would like to see some application of the best practicable means philosophy. U.S.S.R., too, is currently showing great interest in the control methods employed in the U.K.

Canada, in changes that are going on there at the moment, perhaps provides an example of the way that things might develop in other parts of the world. The control of air pollution was first developed in the more populated provinces but quickly spread to the 10 other provinces. But legislation within the various provinces is very diverse. Possibly as a result of this, the Canadian Federal Government in 1971 passed a Clean Air Act which will eventually provide guidance to the provinces although still leaving the main responsibility to them. In the meantime, it functions as a co-ordinating measure. It is next proposed to impose national air quality objectives in the form of a maximum desirable, a maximum acceptable and a maximum tolerable air quality level as the basis of a method of control which will bring together the best practicable means approach with that of a long-term air quality management. We saw earlier that Canada, as a result of colonial and imperial influences in the past had been subjected to two main kinds of legislation—the haphazard and the codified or the British and the French. We also saw that in some instances countries had used the best of both systems to provide their own peculiar system to suit their own peculiar needs. Canada is a case in point and it would seem that Canada is adopting and adapting the best philosophies of both worlds in her clean air legislation; and this might prove to be a model for other countries. Perhaps the Canadian example may spread south of the border to the U.S.A. Perhaps the E.E.C. will recognise that there are merits in both main systems of air pollution control and that they can be married.

Although clean air legislation is comparatively recent and in most instances has all been enacted within the last quarter of a century, many countries are already asking themselves the questions ' How much further do we go? ', and more particularly these days ' How much can we afford to spend? ' and ' How do we spend what money we have? '. Obviously, the money available must be spent to the advantage of mankind. It must not be wasted and therefore must be used realistically and in a practical manner in reaching what is attainable. This might be said to be a plea for the use of the best practicable means. But at the same time, realism must also be used in setting objectives in the shape of air quality standards to act as incentives, always bearing in mind that standards themselves can achieve nothing unless proper control can be and is exerted at the point of emission. To do this some national, deep rooted beliefs may have to be scrapped and more weight given to geography, climate and economics. With a free exchange of ideas between the countries of the world and with goodwill on all sides changes can be made, changes which will lead to even cleaner air.

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"Air Knows No Frontiers"

INTERNATIONAL NEWS

BAVARIA

Bavaria's System for Monitoring the Quality of the Air

by J. Landbrecht, Bavarian State Office for Environmental Protection

An automatic measurement network for continuous monitoring of harmful elements in the air is currently taking shape in Bavaria in the Federal Republic of Germany. This represents an important step in the continuation and intensification of air-quality monitoring in Bavaria, and has become necessary following the rapid development of this part of the Federal Republic from an agricultural into a modern industrialised state, with considerable concentrations of population and industry.

In 1963, in the oil-refinery area of Ingolstadt, the first continuously operative measurement stations came into use for monitoring sulphur-dioxide emissions over a large area. As was common practice at that time, the output of measured data was either made with analog recorders or data printers in the form of infinitely long columns of figures which were almost prohibitive of analysis. Turning this material into meaningful results and statistics used to take weeks. The need for up-to-the-minute data soon became so pressing, that within a few years, in the state capital of Munich, a partly automatic monitoring network was put into operation, with eight checkpoints for continuous measurement of the parameters of sulphur dioxide, carbon monoxide and nitric oxide. The data from all eight checkpoints came to a central location, where they were output on a logging printer and simultaneously onto paper tape for further processing by computer.

The positive experience obtained with this system, together with advances in data-transmission and teleprocessing techniques and the reductions in the prices of computers, plus the sharp rise in the number of pollution parameters to be monitored, all led to the materialization of a completely new kind of automatic, multi-component air-quality monitoring system, which in its final form will consist of 80 measurement stations located in the more densely populated areas of Bavaria and a central station in Munich. The first phase in the realization of this network was completed in August of 1974 and provided for the setting up of 14 measurement stations (Fig. 1).

The Bavarian state office for the environment placed an order for the delivery, integration and putting into operation of the electronic and data-transmission components of the network plus the computers for the whole monitoring system with Rohde & Schwarz. Overall system management is in the hands of the Dornier company.

Network Configuration

Because of the extent of the area to be monitored, the variety of pollutants to be constantly observed, and the necessity for rapid availability of all measured data and information on the functioning of both system and individual components, an automatic on-line measurement system presented itself as the best solution. Reasons of cost alone eliminated all possible system configurations based on the use of permanently leased lines; research into the question showed that use of the public telephone network, with its high transmission quality, would involve lower rentals for the data-transmission aspect at the same investment.

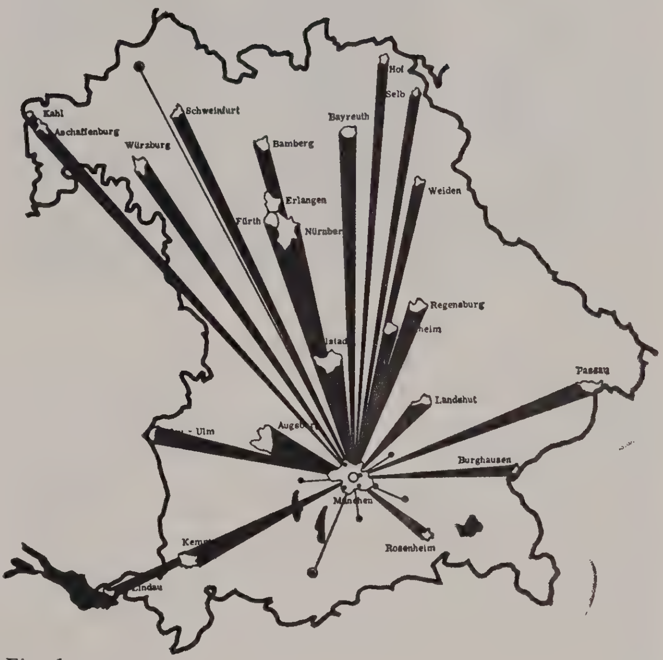

Fig. 1

Instead of continuous transmission of measured data and function checks over permanently leased lines using frequency-division of time-division multiplex, for instance, one has here a system whereby data are acquired at the measurement station by a process control computer, checked for plausibility, concentrated and stored until they are automatically requested by the network's central evaluation station. Automatic calling of the stations occurs every eight hours if the air-quality situation is good. If conditions deteriorate the cycle is automatically shortened by software control or altered at the discretion of the operator.

In the first phase of the network each of the fourteen measurement stations is completely self-sufficient for remote-control purposes and all are compatible from the point of view of data transmission and processing. During the later expansion of the system it is intended to interconnect the additional measurement stations which are located within the same local-exchange network in order to economize on computers and modems. One computer-equipped measurement station in each area of operations will thus assume the role of a central substation, and the non-intelligent stations connected to it will deliver their measured data on-line.

Measurement Station

All the locations for the measurement stations are representative centres of urban-industrial concentration. It is also intended to install two or three clean-air stations as sources of reference, for instance in the Alps or in the Bavarian Forest.

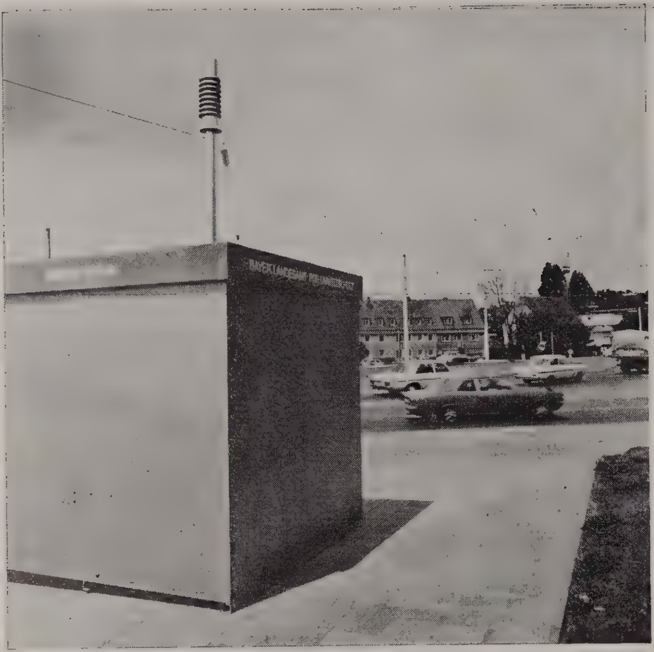

Fig. 2

A measurement station contains a sensor system and appropriate instrumentation for measuring SO_2, CO, C_nH_m, H_2S and dust, plus meteorological parameters such as wind direction and velocity, air temperature, humidity, atmospheric pressure, precipitation and solar radiation. Each measurement station (ground area 2·5 m^2) is fully climatized and has a 7·5 meter-high meteorological mast on the roof (Fig. 2). In principle up to 24 sensors for any parameters can be connected in a measurement station (e.g. for radioactivity, noise, water purity and research purposes in biometeorology). Initially, however, a maximum of 12 channels will be occupied. The pollution data are sampled once a minute and the meteorological values every five seconds. The figures obtained in this manner are converted into half-hour mean values with their variance in the computer and then stored until requested by the central station. The averaging cycle can easily be reduced to ten minutes, for example, this simply being a matter of core-storage capacity in the satellite computer, since peripheral memories, such as magnetic-tape cartridges, are not incorporated for reasons of cost and maintenance.

The analog-to-digital conversion of the signals from the measuring instruments and the transfer of digital data between measuring instrumentation and computer are carried out with, in part, newly developed electronic CAMAC modules (Computer Application to Measurement and Control).

Central Station

The tasks for the central station of the measurement and monitoring network are as follows:

- Automatic calling of all measurement stations and requesting of data.
- Control and monitoring of the functions of the complete measurement network.
- Automatic readout of data on malfunctioning of the system or its components.
- Automatic announcement of the defectiveness of important system components by telephone.
- Data readout showing the air-quality situation, and indication of pollution concentrations referred to time and correlated with meteorological data for periods up to four weeks.
- Smog warnings by telephone.
- Storage of all measured data on magnetic tape for further processing in a large-scale computer.
- Composition of statistics on failures of measuring instruments.
- Keeping track of the dates when maintenance is due at the measurement stations.
- Generation of the machine programs for the satellite computers.

It will be possible at a later date to link large stationary laboratory equipment to the system, such as mass and X-ray spectrometers.

JAPAN

NKK (Nippon Kokan) and Nihon Cement Co Ltd have started a joint study aimed at developing methods for utilising steel works slag as raw material for the production of cement and as aggregate for raw concrete. Tentative goals are the completion of joint studies by early next year to be followed by the start of the construction of facilities producing cement and aggregate.

The disposal of the huge amounts of slag resulting from the steel-making process is a major problem of steel companies. This fiscal year, even though Japan's steel industry is curtailing production, it is estimated that some 40 million tons of slag will be generated. This figure is based on the estimate that for each ton of molten metal produced by blast furnaces some 300 kilograms of slag are generated. For basic oxygen furnaces the figure is some 120 kilograms for each ton of molten steel.

The conventional means of slag disposal is using it as fill for land reclamation or dumping it into the sea. However, in view of pollution control requirements, it is becoming more and more difficult to dispose of the slag by these methods.

NKK already has a special committee to study methods of slag disposal. The committee is engaged in research for developing new disposal methods and technology for commercial utilisation of slag.

WEST GERMANY

Proceeding from the results of the Colloquium on Nitrogen Oxides in 1974, the VDI-Kommission Reinhaltung der Luft has scheduled for September 22nd-24th, 1976 in Düsseldorf an International Colloquium on "Ozone and Related Substances in Photochemical Smog".

This topic is gaining importance world-wide, since phenomena of this type of air pollution can be found not only in the USA, Canada, Japan, and Australia, but also in England, France, Germany, Italy, in the Netherlands, Jugoslavia, Sweden, and in the USSR. The amount of research either completed, running, or planned is very great.

About 30 papers of well known experts will deal with new trends and latest scientific findings in the field of atmospheric chemistry, analytics, and effects of this complex of pollutants.

The complete programme or detailed information can be obtained from the Secretariat of the VDI-Kommission Reinhaltung der Luft, D-4000 Düsseldorf 1, Postfach (POB) 1139.

The International Union of
Air Pollution Prevention Associations

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POLLUTION ABSTRACTS

Papers presented to the NSCA 5th Spring Seminar, Birmingham, 9th-11th March 1976

BACKGROUND TO THE PROBLEM

27 The Public Attitude. F. G. Sugden, Chief Environmental Health Officer, Middlesbrough Borough Council.

In his introductory remarks, Mr. Sugden points to the prevalence of smells in Victorian times and the belief of early sanitary reformers that smells were synonymous with disease. Although our legal powers for dealing with odour nuisances are little altered since 1875, the public attitude towards smells has gradually changed. The author discusses the growing awareness amongst the public of their rights, the economic effect of smells on property values, and of amenity loss. He examines three categories of complaints about odours: (1) individual sources, (2) rural sources and (3) large industrial complexes or very odorous material affecting large areas. The body of the paper concerns action to be taken on complaints about smells from each of these three sources. The author addresses himself to Environmental Health Officers, and speaks knowledgeably from his own experience in this controversial field. The legal position, dealt with in detail in another paper, is briefly referred to in the context of growing public concern. The fears of the public about the possible toxic nature of odoriferous escapes to atmosphere are examined and the author concludes that while it may never be possible to eradicate completely all odour, local authorities should use their planning powers to ensure that difficult premises are sited properly in relation to residential areas.

28 Odour Nuisance—How Can We Stop It? R. G. Goodbody, Environmental Health Officer, Adur District Council.

Environmental Health Officers receive complaints about odours from many and various sources. Of all environmental pollution problems, these can be the most awkward to deal with: identifying the source of the odour and measuring its density requires luck as well as technique. This paper discusses the duties of a local authority in relation to offensive odours. The categories of offensive trades requiring the consent of the local authority under the 1936 Public Health Act are listed. The defence of 'Best Practicable Means' in relation to summary proceedings under this Act are outlined. Planning restrictions and nuisance provisions relating to odour-causing processes are also briefly discussed. In greater detail, Mr. Goodbody examines the legal processes of an action brought by a local authority against an odour-causing works, with some valuable advice on evidence. He discusses the social and economic conflicts involved in the problem, the involvement of the Alkali Inspectorate, and, in conclusion, summarises the credits and debits of an injunction.,

29 Odours—The Second Report of the Working Party. Dr. H. N. M. Stewart, Department of Industry, Warren Spring Laboratory.

The contents of the reports by the Working Party on Odour are summarised. The method of odour measurement and characterisation preferred, the dynamic dilution technique, is discussed. A brief outline is given of techniques for odour abatement and prevention, with comments noted on each from the Report (Part II). Part II also discusses the industries which give rise to odour nuisance in much greater detail than was possible in Part I, and the paper summarises the findings on best present practice in specific industrial contexts: the animal by-products industry, farming, and miscellaneous industries.

30 The Effects (or Possible Effects) of Odours on Health. C. White, Company Medical Adviser, Cadbury Schweppes Ltd.

The notion that bad smells denote the presence of disease, one that was firmly held in the past and is still sometimes believed today, is briefly mentioned. The olfactory function in mammals is referred to, and a medical account of the olfactory mechanism in humans is given. The loss of smell due to prolonged exposure to certain odours is also mentioned. The author categorises odours as harmless, either agreeable or disagreeable, and harmful. The problem within these categories is examined; it is explained that even odours with an acute nuisance value must be assessed apart from those that are actually toxic. The stratagem recommended in relation to odours problems is one of investigation of the source, identification of the substance generated, accurate measurement, then control. The efforts of individuals to protect themselves by gauze masks etc. in difficult atmospheres, and the adoption of this practice by some industries, is exposed as inadequate. In conclusion, the author points out that some smells which would seem intolerable to the general public may quite easily be tolerated by the workforce in the odiferous process.

SOME SPECIFIC PROBLEMS

31 Factors in the Answers to Some Problems. Dr. B. Leadbeater, University of Bradford.

Reasons for the rise in standards required by the public, and the ability of industry to meet such demands for odour abatement, are discussed. The author's experience has shown that certain small industries encounter tremendous problems, both technical and economic, in procuring successful abatement. For larger industries, a duty to develop appropriate controls is felt to exist. The target is defined as no detectable odour outside the factory fence. With reference to Sutton's tall chimney atmospheric dispersion theory incorporated into the 'Memorandum on Chimney Heights' the transmission of odour through the atmosphere is examined. This theory is based on a sampling period of three minutes (mean concentration) but it is shown with the use of figures, that the dilution and dispersion of odour in eddies of wind might cause its presence to be detected for a very short, but finite, period. The problems of cure at source, especially where the nature of the odorous chemicals is unknown, are discussed. The panel technique dedevoped by Warren Spring Laboratory is considered a useful assesment of such problems, but an even simpler, less precise measurement using this method is considered a possibility to permit wider application. Both trade associations and local authorities, it is suggested, might perform such a service. Dr. Leadbeater considers that there can be no one simple solution to many odours problems, and expects that discussion during the seminar will provide a fruitful pooling of experience.

32 Odours from the Food and Fish Processing Industries. D. D. Singer and Mrs. R. O. Hunt, Ministry of Agriculture, Fisheries and Food.

In this review article, the problems of treating odours from the food and fish processing industries are outlined as being (1) the complex nature of chemical mixtures involved (2) objective analysis of the presence of a malodour and (3) subsequent choice of the best method for odour elimination. The processes implicated most frequently in odour emission include vegetable processing, deep fat frying eg. of chips, crisps, fish fingers; coffee roasting, fish and fishmeal processing, fermentation processes and waste processing. (Meat production and by-products are not covered). Public reaction and legal aspects are discussed. Present methods of detection include the syringe and dynamic dilution methods. Thirteen control methods including adsorption, absorption, oxidation, filtration and neutralisation and their applications to the industry are considered. Results of a wet oxidation ozonisation system applied to fishmeal processing are described.

33 Farming. C. T. Riley, Agricultural Waste Management.

The problem of odours in farming is derived from three main sources: emissions from animal houses; disposal of wastes on land; and the drying of crops and wastes. The author emphasises the importance of good husbandry and economic production in the elimination of odours. Good farming requires care in respect of soil health, animal welfare, river and groundwater pollution, energy conservation and recycling, all of which are examined in relation to the economic and practical feasibility of odour elimination. Mr. Riley points out that farming smells have become an increased problem in relation to residents, possibly new to agricultural life, in the surrounding downwind area. He outlines current European research and advice available on the problem, and in greater detail, advises on control for animal house odours, for manure storage, for silage crops, and for manure driers. In conclusion, recycled farming wastes are an economically important part of good husbandry, and although more research is needed, the removal of the odours problems involved is possible, but the complete elimination of odour is beyond economic credibility.

34 Animal By-Products. K. Sharples, Raw Fat and Bone Processers Association.

The paper examines the broad outlines of odour problems encountered in the animal by-products industry. The biological aspect of the trade necessitates strict controls and a speedy processing of the raw material. The economics of the removal of animal remains to the processing factory are discussed prior to a general examination of the processes involved in the reduction to tallow and meat meal, with consideration of the points at which a severe odour problem might arise. After examining the traditional method, Mr. Sharples outlines four basic continuous rendering systems. Blood processing and its difficulties are briefly discussed. In the paper's second section, the author justifies the existence of an animal by-products industry and produces statistics to prove his case. The final section is devoted to a broad examination of the industry's problems, and an analysis of atmospheric pollution problems associated with the unit operations employed; suggestions on treatment are made. Legislation as it affects the industry is discussed, with conclusions on future developments of the treatment of odours by the animal by-products industry.

SOME ANSWERS AND SOME SUCCESSES

35 The Incineration of Exhaust Fumes from Solvent Based Paint Stoving Ovens. J. I. Morris, John Thurley Ltd., Harrogate.

The stoving of paints after application can cause unacceptable levels of atmospheric pollution around the drying plant as the paint solvent is exhausted to atmosphere. The paper presents one solution, the technique of incineration or high temperature oxidation, describing the basic principles and showing how these techniques have been applied in practice. After describing the general nature of the problem, the author examines the requirements of a thermal incinerator to obtain the most efficient oxidation of solvent pollutants under the three headings of temperature, time and turbulence. Four methods of obtaining adequate turbulence are given. A general guide to the mechanical design of incinerators is presented briefly. Types of burners used in fume incinerators are examined; particular attention is paid to a burner designed to operate close to the stoichiometric air to fuel ratio over the full range of turn-down. Techniques of heat recovery that can be incorporated in the overall system design are discussed. A typical installation of a Combustifume incinerator with heat recovery, on a car body plant, is illustrated.

36 Adsorption—Activated Carbon —An Ubiquitous Substance? Dr. I. Young, Sutcliffe Speakman & Co. Ltd.

This paper examines the properties of activated carbon and its uses in the removal of odour in both gas and liquid phases. The author explains the derivation and characteristics of carbons from coconut shell, coal and wood, and the appropriate uses of each activated form related to pore size. The adsorption process is examined in theory; an explanation of the adsorption isotherm typical of activated carbon is given. Illustrating his remarks with practical examples from Sutcliffe, Speakman's experience, Dr. Young discusses the use of activated carbon in the control of gaseous pollution of the atmosphere in two forms: small concentrations of highly odorous compounds, and larger concentrations of usually less odorous material which may or may not be toxic. Techniques in deodorising, solvent recovery, and liquid phase treatment are examined in general review; the author concludes that activated carbon is not a panacea, but as a useful adjunct to many existing processes it is indeed an ubiquitous substance.

37 Catalytic Combustion and the Control of Air Pollution. R. A. Searles, Johnson Matthey Chemicals Ltd.

This paper discusses the use of catalysts in the combustion control of odoriferous gases. In oxidation reactions, the catalyst greatly lowers the temperatures required for the oxidation of malodorous compounds to take place. A table is appended, showing processes producing malodorous effluent gases that may be treated by catalytic incineration. The author advocates the use of platinum catalysts, and discusses advanced catalyst systems developed in the last twenty years. Refinement of such systems has led to the development of ceramic honeycombs as a suitable proprietary support material. The Honeycat (R) range of air pollution control units is illustrated with tables and figures. The application of this system to field problems, and the various pollution problems that can be solved, are outlined. Two case studies, to show the method of operation, are examined and illustrated.

38 Odour Control by Absorption Techniques. A. T. Canton, Peabody Holmes Ltd.

The paper presents a survey of the absorption process applied to odour control; techniques, process designs and industries to which these may be applied are discussed. After an account of liquid phase absorption, the author summarises some of the basic chemistry relating to the most commonly used oxidising agents applied to liquid phase odour removal equipment. Associated problems are discussed, particularly the removal of condensible fractions. The principles and requirements of absorption tower design are examined in detail with figures illustrating application. Spray and packed designs are both assessed, and the efficiencies of different types of contact plate to give the best heat/mass transfer rates are explained. Examples of odour control by absorption techniques are given, with the chief odour-producing problem in each being listed. The author stresses the need to compare odour control equipment types, and possibly test on pilot scale for new problems, but feels that absorption is an important technique in applying 'best practicable means' to odour control.

THE FUTURE

39 Research and Development. A. A. North, Air Pollution Division, Warren Spring Laboratory.

The general objectives of the Warren Spring Research programme on odours are outlined; success in this overall programme depends on finding satisfactory methods for odour measurement both on-site and in laboratories. The mobile odour assessment laboratory is described in detail. This method depends on the sensory assessment by panellists of odours diluted dynamically under strictly controlled conditions. Although it is subjective, the typical human nose is very sensitive to even a few parts per billion of odoriferous organic compounds in the air. It has not proved possible to produce instruments of comparable sensitivity; some means of pre-concentration of odour is generally required. Trapping techniques are described and evaluated. Sensory assessment of the resolved compounds can then be made using the different instrumental detection techniques appropriate to each process. The development of techniques for the sensory evaluation and instrumental analysis of odours is now becoming sufficient to be of service in research and development of methods for prevention and abatement of odour nuisance.

The above seminar papers are available at 60 pence each (inclusive of p & p)
Complete sets, including Part II (discussions on papers) are available at £5·75
(inclusive of p & p)

From: NSCA, 136 North Street, Brighton BN1 1RG
Tel: (0273) 26313

ENPOCON

The 3rd Environmental Pollution Control (ENPOCON) Exhibition will be held at the National Exhibition Centre, Birmingham, from 15th-20th November 1976.

It will cover all equipment, plant, products, services, systems and supplies associated with the fight against environmental pollution—solid waste pollution, air pollution, noise and vibration pollution, radiation pollution and sea and waterways pollution.

The event will run concurrently with the Effluent and Water Treatment and the Public Works Exhibitions.

The Exhibition Organisers are Brintex Exhibitions Ltd., 178-202 Great Portland Street, London W1N 6NH. Telephone: 01-637 2400. Exhibition Manager: Howard Phillips.

Eutrophication of Lakes & Reservoirs

Eutrophication of Lakes & Reservoirs will be the theme of a Symposium, organised by the Institution of Public Health Engineers, at Queens' University, Belfast, from the 9-10th of September 1976.

It is perhaps convenient that the symposium should be held in Belfast as it lies close to Lough Neagh which exemplifies the problems arising from eutrophication. Lough Neagh has a surface area of 148 square miles and has been under continuous research since 1968 by the Freshwater Biological Investigation Unit. The Department of the Environment (N.I.) has commenced a programme of phosphorus reduction to be implemented at the major sewage disposal works on the lough.

There will be papers dealing with the Lough Neagh situation from the Investigation Unit and the Department of the Environment (N.I.). Eutrophication is found in Killarney, Sheelin and Ennell and there will be a number of papers from those concerned with the problem in Eire. From the United Kingdom there will be papers on the Farmoor Reservoir and on living with the problem. In Sweden a good deal of success has been achieved in combatting eutrophication and this will be the subject of a further paper.

The full programme can be obtained from the IPHE, 32 Eccleston Square, Westminster, London SW1V 1PE. Tel: 01-834 3017.

Open University

The one year Open University course, Environmental Control and Public Health, is again being offered to students in the 1977 session. It is one of 21 courses in the Post-experience programme which is designed for adults who wish to broaden their educational experience.

No formal educational qualifications are required for the course, and like all Open University courses teaching is carried out through correspondence texts backed-up by television and radio programmes.

In tracing the growth of concern with public health and related legislation, Environmental Control seeks to show how we may control those environmental factors which affect community health.

The course is concerned with the management of limited natural resources; the availability of unpolluted air and water; disposal of domestic and industrial wastes; noise control and the legislation needed to control major environmental problems. A key theme of the course is the inter-relatedness of environmental problems, and how an integrated approach to solving them is necessary.

The course has been designed for those with a professional interest in the environment and for laymen who wish to take an informed stand on environmental issues. It will enable those with executive functions in environmental matters to place their work in a broader framework and to achieve a fuller understanding of the interactions of environmental factors.

The application period for Post-experience courses is from April 22nd to October 15th, and applicants should apply to the Post-experience Student Office, The Open University, PO Box 76, Walton Hall, Milton Keynes MK7 6AA.

ENGINEERING DIESELS FOR LEGISLATION

A review of developments at Perkins Engines by

R. BERTODO

Address to the National Society for Clean Air
Peterborough
4th September 1975

INTRODUCTION

The last few years have seen a degree of activity in the prime mover field unparalleled in peace time since the early days of the internal combustion engine. This engineering revival probably started in the late 1960s as an attempt by engine manufacturers to improve the competitiveness of their products in response to market pressure. A wave of emotional, controversial and often misguided legislation followed soon after as the "fall-out" of an American ecological campaign. Such legislation has led to the enactment of legal controls on noise, smoke and emissions world-wide with no co-ordination with regard to timing, test standards or basic aims and in total disregard to interactions between the various aspects legislated on. The nett result has been fragmentation of control and repeated revisions of implementation strategies. The energy crisis has now added a further dimension to the general confusion, since the legislator's aims are invariably in conflict with fuel economy.

Faced with this volatile and uncertain situation, in 1969 Perkins Engines set out an engineering programme aimed at ensuring its international viability by meeting the toughest world-wide legislation in the shortest foreseen timescale requirement with all its major products. These objectives were subsequently revised, in the light of the energy crisis and relaxations of both European and N. American standards. It is now foreseen that European legislation will be slanted predominantly towards the control of noise, smoke and odour with some encouragement to fuel economy. American legislators appear likely to pursue the enforcement of tight emission control, but noise attenuation will become increasingly important. It is likely that fuel quality will degrade. It is thought that the remainder of the world will align itself with one or other of these two trends.

In line with the above scenario, the following engineering targets are currently in view:

- Noise to be reduced by 10 dB(A) @ 1m from bare engines under anechoic conditions by 1980. A noise reduction package is being offered now for all engines in the product range giving reductions of 3-6 dB(A) @ 1m.
- All production engines to comply with a maximum steady state smoke level of less than ¾ BSAu 141a specified levels by 1978. Most engines in the product range currently comply with BSAu 141a. (EEC 72/306.)
- Free acceleration smoke not to exceed 25 HSmU (Hartridge Smoke Units) by 1978. Levels below 45 HSmU are currently recorded from production engines. This is within EEC free acceleration limits.
- Combined (NOx + HC) emission levels not to exceed 5g/bhp.h on the CARB (California Air Resources Board) 13 mode cycle for model year 1977. These levels have been achieved in development, but certification has been held in abeyance pending clarification of EPA (Environmental Protection Agency) intentions regarding HC levels.
- Engines for light duty applications to meet 3·1 g/ml NOx on the CVS (Constant Volume Sampling) cycle by 1976 and 2·0 g/ml NOx by 1977. The former has been achieved and certification at the 2·0 g/ml level is planned for late 1976.
- A specific fuel consumption improvement of at least 5% by 1978 coupled with greater fuel quality tolerance. Both targets have been met on selected development units.
- An understanding of diesel exhaust odour formation and the development of a control strategy during this year. A fundamental research programme is well underway and the planned target will be met.

It is expected that the completion of the engineering programme outlined will allow all currently known, proposed or planned legislation to be met on time and in an orderly fashion. Clearly, significant advances have already been made and these have led to a radical revision of design philosophies accepted only a few years ago. The present paper outlines, briefly, the developments which have led to the new engine concepts, describes the implementation problems and discusses the scope for future developments.

POLLUTION GENERATION

The main pollutants associated with diesel engines are noise, smoke (carbon formation emitted as exhaust soot) gas emissions (mainly oxides of nitrogen and unburnt hydrocarbons) and odour. All are formed during the various combustion stages. Until recently, legislation has been most stringent on the control of oxides of nitrogen (NOx) levels and smoke.

Air-fuel mixing in the combustion chamber of a high speed diesel is characterized by the injection of fuel in the form of a fine spray into a highly swirling compressed air charge. This air movement causes breakaway of the smaller droplets: these decompose to form peroxides and aldehyde intermediates. If these compounds are not fully consumed in the subsequent combustion then highly odorous oxygenates are carried over into the exhaust. A series of fast chain reactions follow the initial spray disruption leading to spontaneous ignition and combustion from the several favourable points in the heterogeneous mixture near the spray leading edge. Photographic studies show that these ignition points propagate rapidly, giving rise to a general conflagration notable for its violent heat release and pressure development. The pressure development yields an energy pulse ("diesel knock") evident as noise. Oxides of nitrogen are formed in high concentrations at points coincidental with these ignition points due to the favourable temperatures.

As the flame propagates towards the fuel spray core, combustion stabilizes and temperature conditions and oxygen availability favour NOx formation at part-load and smoke near full-load. The spray tail towards the end of injection consists mainly of large droplets difficult to oxidise and thus likely to promote smoke and unburnt hydrocarbons (HC).

The situation can be summarized as follows:

Pre-ignition	odorants
Spontaneous ignition	NOx, noise
Steady burning	NOx and/or smoke
Spray tail	Smoke and/or HC

In the light of the foregoing, pollution control at source requires low ignition delay periods, high air-fuel mixing rates to avoid "hot spots", low cycle temperatures to minimize NOx, and sharp fuel cut off to eliminate the adverse impact of the spray tail. Modification of this kind impairs fuel economy, as discussed later, and palliatives have usually been resorted to in the first instance.

PERKINS ENGINES

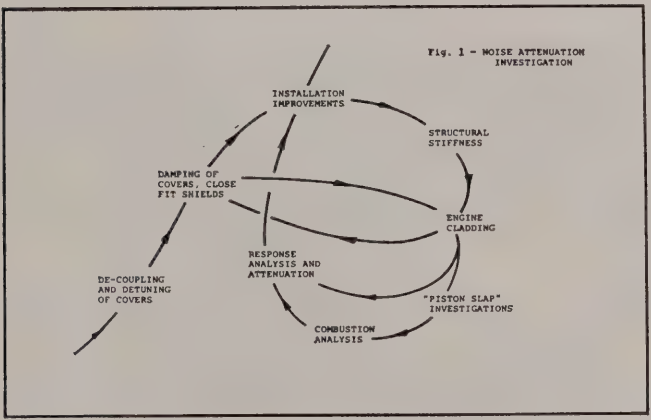
Fig. 1 - NOISE ATTENUATION INVESTIGATION
INSTALLATION IMPROVEMENTS
STRUCTURAL STIFFNESS
DAMPING OF COVERS, CLOSE FIT SHIELDS
ENGINE CLADDING
RESPONSE ANALYSIS AND ATTENUATION
DE-COUPLING AND DETUNING OF COVERS
"PISTON SLAP" INVESTIGATIONS
COMBUSTION ANALYSIS

Fig. 1

NOISE ATTENUATION

Transmission of combustion energy to the outer surfaces occurs in three main ways:

- Through the cylinder head, to cause vibration of the rocker covers and similar items located above the engine. Valve gear "clatter" is unconnected and is usually a secondary noise source.
- Through the liner walls, to excite the outer surfaces of the main structure and, through this, attachments such as the sump pan and timing gear cover. In this connection, water cooling provides a significant and welcome attenuation effect.
- Through the piston, causing "piston slap", down the connecting rod and into the main bearing saddles, contributing to "mechanical" noise (particularly on worn engines), and reinforcing structure vibration from the liner transmission.

The total engine noise characteristics are complicated by a number of related sources, for example cooling fan exhaust and intake, and by secondary contributions, usually evident on "silenced" engines, such as gear trains and fuel injection equipment.

Because of disparaging comparisons with gasolene engines, diesel engine noise reduction has drawn many investigations. Interest pre-dates legislation, but for historical and technological reasons the work has followed a convoluted and complex path, as shown in fig. 1. Early investigations were aimed at detuning (changing the frequency) and/or decoupling (isolating) the three main covers: those covering the valve gear mechanism, timing gear assembly and oil sump. These are invariably high radiation areas. Interference with the thermodynamic cycle of the engine was avoided, because of the potential adverse impact on power, smoke and sfc. (specific fuel consumption). To minimise tooling changes and hence product cost impact, the main structure was also left alone.

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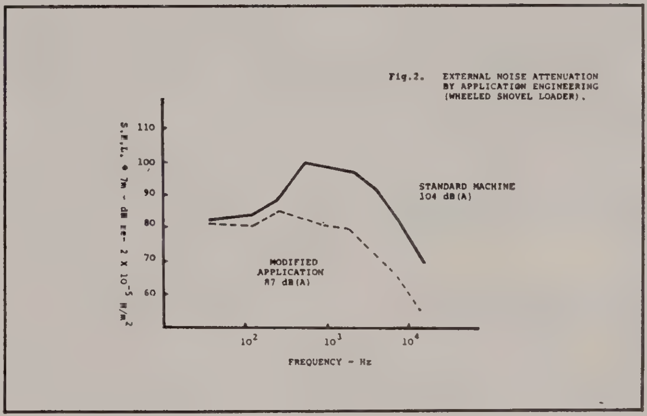

Fig. 2

The scope of noise attenuation by decoupling and detuning covers is relatively limited, consequently damping of these components, either with rubber-like materials or by exploiting the frictional effects of double skin construction, was also examined. Reduction of 2-3 dB(A) @ 1m under anechoic conditions were attained from engines treated in this manner, provided a double skinned close fitting shield was fitted to the block sides. The cost effectiveness of the technique was not acceptable, however, and only limited production was attempted on a restricted range of components for critical applications.

This work was coincidental with a series of installation appraisals which revealed that, particularly on agricultural and industrial equipment, the engine was not the major source of noise. Application engineering deficiencies associated with the engine cooling system and inlet and exhaust trunking hardware were the main contributors. Attenuations of up to 10 dB(A) at 7m and up to 25 dB(A) at the driving position were achieved without engine changes (1) (2). Even on road vehicles a 3 dB reduction required a contribution of at least 6 dB from the bare engine. Some representative data is shown in fig. 2.

The realization that massive reductions could be obtained simply by installation modifications led naturally to the conclusion that compromise of engine performance for relatively minor noise reductions could not be tolerated. The engine's thermodynamic cycle should be optimized for power, smoke, emissions and sfc only. In line with this thinking, investigations aimed at reducing combustion noise were downgraded in priority and attention turned to stiffened main structure engines as a way of reducing noise. In practice this did not prove a fruitful line of investigation since very large stiffness increases were found necessary: although three engine structures were designed, manufactured and tested all proved excessively heavy. In one case the added stiffness actually increased the overall noise level on the dB(A) scale due to adverse changes in the frequency response of the structure.

Some theoretical studies of the potentials of total engine enclosure were undertaken, but these tended to suggest that the relative cost would not be acceptable. Surface cladding coupled with close fitting block side-shields proved a much more rewarding line of attack. By 1972 a 2-3 dB(A) at 1m attenuation had been obtained using plastic foam/steel shields. The cost of the package was still excessive and it was not until last year that a commercially viable asbestos/lead/asbestos treatment was evolved. This is capable of bare engine attenuations of 3-6 dB(A) @ 1m, the larger reduction being recorded on the smaller high speed engines subjected to the more rigorous legislation. Typical noise levels in treated and untreated conditions are shown in fig. 3 for a small high speed diesel.

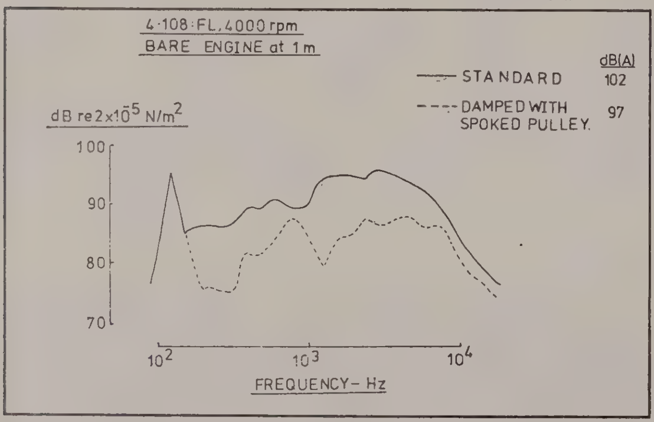
PERKINS ENGINES

Fig. 3

The earlier work on structural stiffness had shown that significant changes in the frequency response of a structure, such as an engine block, could be modified by design changes. It seemed likely that if the exciting forces could be quantified and their transmission through the structure as vibrational energy modelled, then the transfer of energy to the surrounding air as radiated noise might be calculable. If successful, this approach would open the way to estimating engine noise levels at the design stage. There is no practical alternative way of exploring the implications of the massive attenuations likely to be demanded by legislators towards the end of the decade. The development of appropriate theoretical techniques is already well advanced and some preliminary results were published at the recent CIMAC Conference (3).

The method consists essentially of determining from the thermodynamic characteristics of the engine both the combustion frequency spectrum and the subsequent energy transfer mechanism. A better understanding of factors leading to "piston slap" and affecting combustion noise is required. From this, statistical energy transfer parameters are obtained and, by considering the structure response to pulse excitation, the space average velocity of the outer surfaces are derived. If the radiation efficiency is known, the radiated noise can be, and has been, calculated. These calculations are currently subject to an error of up to 2 dB(A) in overall levels and up to 3 dB in individual third octave bands.

The foregoing has outlined the many aspects of bare engine noise reduction considered during the Perkins Engines programme of legislation related engineering development. It is clearly obvious from this work that noise reduction on the engine as against reduction by installation engineering is expensive and time consuming if the engine performance is not to be degraded. Thermodynamic cycle modifications can have a favourable impact on engine noise and these aspects are reviewed in later sections.

STEADY STATE SMOKE EMISSION

Steady state production smoke levels are governed in the U.K. by BSAu 141a: this standard is essentially identical to EEC 73/306 and will become effective this year. The standard demands that 99% of production engines achieve the minimum declared power and do not exceed the legislated smoke level. Further, 99·9% of production engines must not exceed the legislated smoke level by more than 5 HSmU or fall by more than 1½% below the declared minimum horse power. The legislated smoke level is expected to be reduced by 25% within 2-3 years. Most products in the Perkins product range will meet this statute on time, subject to enactment. This regulation is the most demanding worldwide requirement for steady state smoke and calls for exhaust clarity levels significantly better than those required for N. America (15% USPHS lugging).

Compliance with BSAu 141a levels has been possible without major engine changes, but with a considerable increase in the degree of specification control. The attainment of forecast future smoke requirements is more problematic and significant engine changes would seem necessary. Experience suggests that the following items have a predominant influence on engine behaviour under volume production conditions.

- Inlet port profile—engine-to-engine and cylinder-to-cylinder variations have a first order impact on consistency of smoke due to its influence on air swirl. Flow checking has been adopted as standard and machining of ports was found necessary on at least one engine.
- Piston topping and valve recess depth—tolerances have been tightened as a means of controlling both dead volume and compression ratio.
- Fuel pump drive—heavy duty drives have been adopted as standard to reduce cycle-to-cycle variations. Mechanical governors and controlled flow, reduced sac volume injectors have been specified. These changes have a major impact on low speed smoke.
- Fuel pump setting—tighter controls have been introduced and pump test machine modifications made to reduce setting errors.
- Engine timing—engine timing accuracy has been improved from ±4° to ±2°. This has a major influence on torque and power scatter at fixed smoke levels.

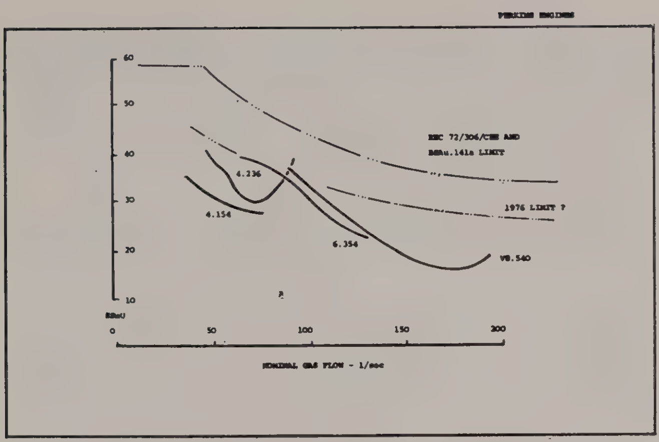

Fig. 4

The smoke levels obtained from four typical production engines are shown in fig. 4. The margin is obviously inadequate to meet the foreseen 25% reduction and development activities have shown the adoption of gaseous emission control features as an essential requirement.

FREE ACCELERATION SMOKE CONTROL

Free acceleration smoke control has been most troublesome on turbocharged engines: this is essentially due to mismatch between fuel supplied and air available from the turbocharger during transient operation at no load. The problem is accentuated by the subjective nature of the road-side test and the lack of correlation between test bed mounted engine behaviour and installed engine smoke due to the influence of application parts on inlet depression and exhaust back pressure. Therefore, very low free acceleration smoke levels are demanded from the engine to accommodate installation vagaries.

Short term activities have hinged on obtaining a better fuel/air match under representative conditions. As an example, the following results have been obtained on T6.354.3(V) engines under free acceleration conditions.

Fuel Injection Equipment Specification	**HSmU**
C.E.I.* pump with low speed fuel chop	up to 60
C.B.I.** pump with boost control	40-45
C.E.I. pump with boost control	~35
C.E.I. pump with acceleration delay	~30

The last option has a potential impact on gear change performance and various acceleration delay times are being investigated.

For longer term application five alternative pressure charging systems are currently under development; these are:

Licencia "Autokut" system—essentially low speed tuned manifolds. The size and shape of these manifolds lead to severe application restrictions.

Perkins "Air by-pass" system—currently the subject of a patent application.

Brown-Boveri "Comprex" system—an exhaust pulse turbocharger. The system is currently penalized by its high "whine" noise and high cycle temperatures leading to large air charge coolers or adverse NOx emissions. A major cost impact has to be absorbed and this is not offset by the higher low speed torque obtained.

Plessey "Cross Bleed Combustion" systems—which incorporates an auxiliary combustion chamber for low speed operation, but suffers from inferior fuel consumption.

Perkins/Gosling Compressor—a novel supercharging system.

**C.E.I.—constant end of injection*

***C.B.I.—constant beginning of injection*

The objective of all these systems is the improvement of air throughput at low speed, light load and under transient conditions.

GASEOUS EMISSIONS CONTROL

Indirect Injection Engines

Although work on visible emissions was started in the mid-1960s (4), investigations into invisible emissions did not begin until 1970. A detailed survey of reciprocating prime mover exhaust quality (5) revealed the following:

	CO%	NOx ppm	HC ppm
Spark-ignited —light duty	2-5½%	1000–2500	2500–3750
—heavy duty			500–2000
Compression-Ignition —indirect injection	0.1–0.25%	320–780	10–160
—direct injection		1100–2000	20–260

suggesting that diesel engines might be rather good at meeting "gasolene" engine oriented legislation. It also showed potential NOx problem with naturally aspirated direct injection engines. This was verified by a parallel survey of Perkins production engines.

A subsequent development covering the Perkins A and H chambers and the Ricardo Comet Vb, all of the swirl type, as well as the Perkins R pre-chamber, indicated that all could meet the 3·1 g/ml NOx level on the CVS cycle (roughly equivalent to 5 g/bhp.h (NOx + HC) on the CARB 13 mode cycle). Only minor modifications were necessary such as a reduction in injector overlap and gap volume, retarded injection timing, marginally higher injector breaking pressure and the addition of a light load advance mechanism to the fuel injector pump.

By re-optmising the chamber volume, compression ratio and fuel injection equipment, a level of 2·0 g/ml NOx on the CVS cycle was feasible. If even lower levels were required then a major innovative step would be needed. It seemed unlikely that such very low pollutant levels would be required, except perhaps for motor-cars, before the end of the decade and attention consequently switched to the more problematic direct injection engine.

Direct Injection Engines

Naturally aspirated direct injection diesels are predominant in heavy duty applications below about 150kW because of their outstanding fuel economy (fig. 5). As discussed earlier the exhaust quality of these engines could be improved by closer control of NOx formation by lowering the peak cycle temperature, eliminating hot spots during combustion or restricting oxygen availability. Technically, the most straightforward way of reducing combustion temperatures is through turbocharging and inter-cooling without power enhancement. The supply of large quantities of excess air in this manner is not economically feasible for engines below 150 kW.

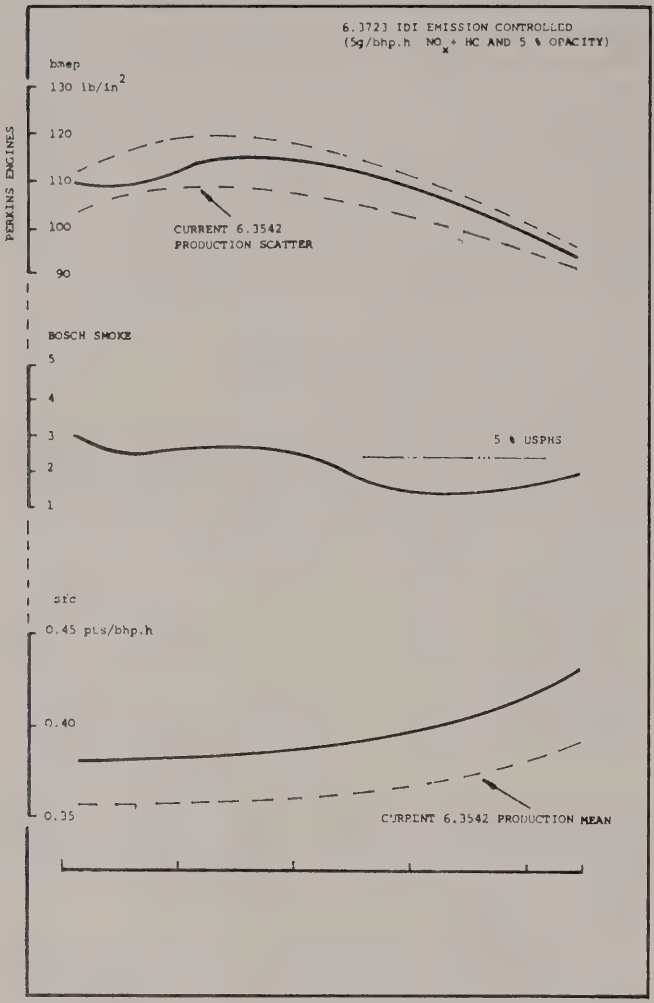

Fig. 5

A number of alternative options exist (6) and the following were explored in some detail:

- Fumigation and pilot injection (pre-injection of part of the fuel to reduce burning rate).
- Water injection (utilizing latent heat to reduce cycle temperature).
- Exhaust gas recirculation (thus restricting oxygen availability) and
- Derating with or without injection retard (the latter reduces cycle temperatures by absorbing heat to work during combustion).

These preliminary investigations were unsuccessful, but it seemed clear that any practical control system would incorporate retarded injection timing as a temperature, and hence NOx, reducing feature. Resultant problems of light load misfire, and consequent increases in unburnt hydro-carbon emissions, would require resolution. The fuel consumption penalties and high exhaust smoke levels associated with retarded combustion would also have to be accommodated. In view of this, the possibility of combining a very late timed engine with catalytic converters in the exhaust manifold, for HC oxidation, and soot filter in the silencer was considered. Although technically feasible, the proposal was not considered commercially viable.

At this stage considerations were first given to a speculative research programme aimed at evolving a thermodynamic cycle compatible with market requirements for low fuel consumption and legislative needs for pollution control. It appeared necessary, from the earlier discussion, to increase the air-fuel mixing rate since this would minimize the incidence of NOx promoting hot spots. This would also improve efficiency, reduce smoke and shorten the burning period. The latter allowed injection to be retarded, thus reducing cycle temperatures and NOx formation.

The air motion within the cylinder of a direct injection high speed diesel is composed of an inlet port generated tangential velocity (swirl) and a radial component (squish) caused by piston reciprocation. The swirl movement is predominant. It seemed feasible to suppose that a strengthened squish flow component could be made to interact with the conventional swirl motion so as to create a significant degree of turbulence within the chamber. This turbulence would lead to higher fuel-air mixing rates. Flow visualization studies showed that the approach was feasible and led to a revised combustion chamber profile (fig. 6).

PERKINS "SQUISH LIP" COMBUSTION SYSTEM

The new combustion system has an optimum dynamic injection timing of 8° BTDC. At this timing, the system is up to 7% more efficient than the standard direct injection engines, the combined (NOx + HC) levels on the CARB 13 mode cycle are in the neighbourhood of 7½-8 g/bhp.h and the lugging smoke level does not exceed 7½% on the USPHS meter. Retarding the timing to 3° BTDC degrades the thermal efficiency to a level comparable with that of a conventional high swirl direct injection engine, but reduces the emission level on the 13 mode cycle below 5 g/bhp.h at opacity levels of the order of 5% (~2 Bosch) at peak torque.

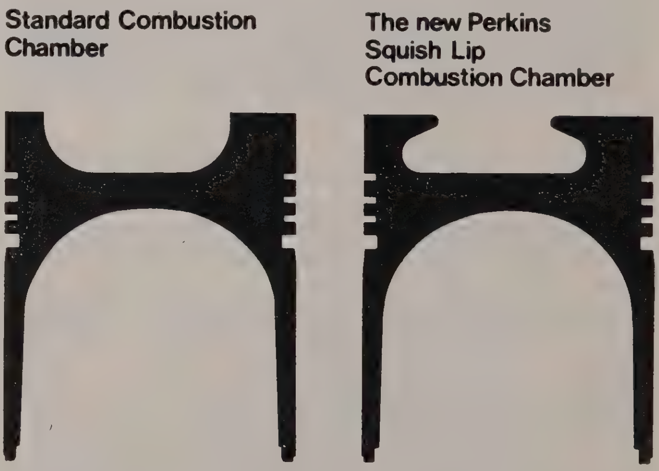
Standard Combustion Chamber
The new Perkins Squish Lip Combustion Chamber

Fig. 6

Heat balance data indicated a full load thermal efficiency of 31·5 ± 3% when timed for low emissions, rising to 33·4% at a timing coincidental with maximum fuel economy. This compared with 32·5% for the standard direct injection engine. Fuel economy was significantly better than for the standard engine at low speeds and progressively degraded as rated speed was approached (fig.7). This was due predominantly to the later heat release and losses through the chamber throat. The degradation occurred at sufficiently high rotational speeds not to affect the calculated efficiencies on representative operating cycles. More detailed analysis of the heat balance data showed a general redistribution of heat rejection to the cooling system, due to the lower cycle temperatures, with higher heat to exhaust and lubricating oil, as a result of the late timing.

The late injection timing, coupled with the smoother heat release rates, gave major reductions in peak firing pressures and their related rates of pressure rise. Typically, peak pressures reduced from 9·65 MN/m^2 (1400 lb/in^2) to 6·55 MN/m^2 (950 lb/in^2) and rates of pressure rise from 0·83 MN/m^{2}deg. crank (120 lb/in^2/deg. crank) to 0·28 MN/m^{2}deg. crank (40 lb/in^2/deg. crank). This implied that combustion took place at more nearly constant pressure helping to reduce sensitivity to fuel quality.

This has been confirmed by extended running with selected fuels in the Cetane Rating range 38-62 without difficulties. Since combustion generated noise is extremely sensitive to rates of pressure rise, reductions of 3-6 dB(A) at 1m were recorded from bare engines in anechoic chambers. The reductions were particularly significant since the rates of pressure rise were only marginally affected by the ignition delay and hence by fuel quality and cycle to cycle variations. Marked improvements in odour rating were noted.

Since the original experiments, further chamber modifications have led to a 2nd Generation system, capable of operating at higher outputs and a third system with a radically different chamber leading to greater fuel economy. The comparative characteristics of the various systems are tabulated below:

IMPLEMENTATION PROBLEMS

The practical implementation of R & D achievements has proved difficult, predominantly due to the fragmented manner in which legislation has been enacted and the unrealistic lead times set by some authorities.

Since the beginning of the decade a legislative framework has been established for noise (operator and third party), smoke (steady state and free acceleration), gaseous emissions (oxides of nitrogen, carbon monoxide and unburnt hydrocarbons) and output power scatter. These laws, rules and regulations, numbering over 300 in the industrialised world, have been promulgated with scant regard for anything other than narrow national factors. Consequently, when viewed from an international position they are seen as often contradictory and invariably in conflict with regard to basic aims, economic implications, technical feasibility and timing. An even larger mass of legislation is promised for the future: the likelihood that legislators will agree on international standards for such simple common denominators as test methods equipment and cycles, appears remote. The likelihood of controls on oxides of sulphur, exhaust odour and over-the-road fuel economy can only be expected to compound the overall disorder.

Since 1970, Perkins Engines' R & D effort, attributable to legislation inspired programmes, has risen tenfold and now accounts for 70% of the total Engineering spend. It is estimated (fig. 8) that by 1980, programmes aimed at satisfying world-wide legislation on smoke, emissions and noise alone will amount for 80% of the Engineering commitment. This expenditure, now running at several million pounds annually, has led to a marked contraction in new product development and existing product maintenance. New products, for example, have declined from approximately 40% in 1970 to 15% currently. Whether this trend is to the ultimate benefit of the end user in particular and the community in general is questionable. This is particularly so, since it is patently avoidable. An international agreement on test equipment and methods alone would lead to a major saving of engineering resources. All pollutants are generated during the combustion stage. Combustion characteristics can be adjusted to favour particular pollutants or produce a "balance of pollution". Legislation at present does not recognise this, but assumes that each pollutant can be controlled in isolation with no side-effects.

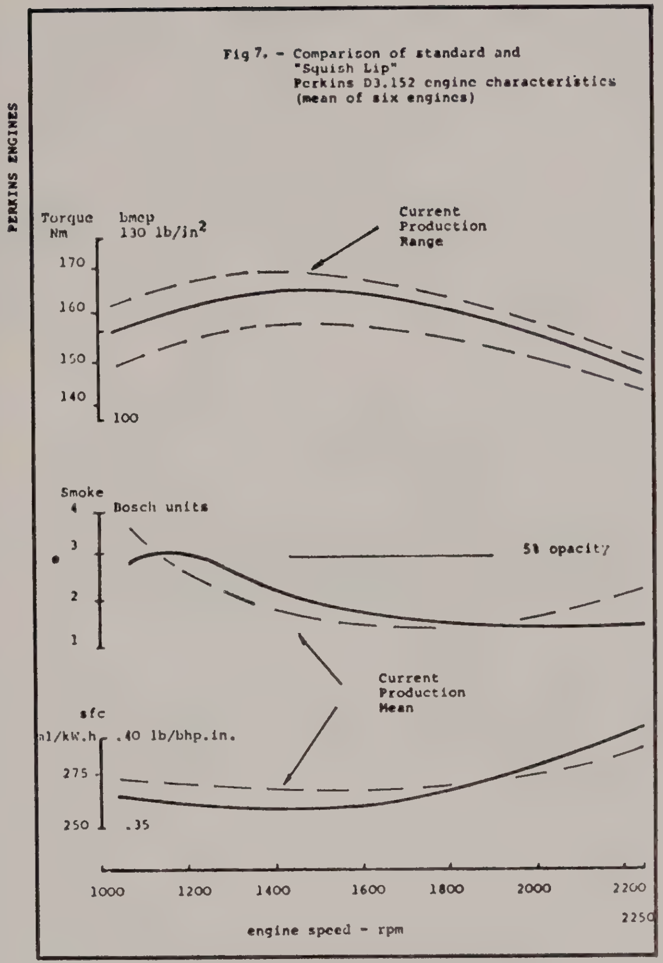

Fig. 7

	Baseline Engine	1st Generation "Squish Lip"	2nd Generation "Squish Lip"	"SLED 3" System
SMOKE—% USPHS	7½–10	4–5	5–7½	5–7½
NOx—g/bhp.h, 13 mode	14.2	3.36	3.38	3.52
HC—g/bhp.h, 13 mode	3.1	1.47	1.50	1.31
CO—g/bhp.h, 13 mode	8.7	6.2	6.7	5.8
ODOUR—TIA average	2.3–2.4	1.9	2.0	1.9
NOISE—dB(A) @ Im	96	90½	91½	91
SFC—full load ml/kW.h	280/292	295	314	292
RATING—kW @ rpm	31½ @ 2250 34 @ 2600	31½ @ 2250	34 @ 2600	23 @ 3600

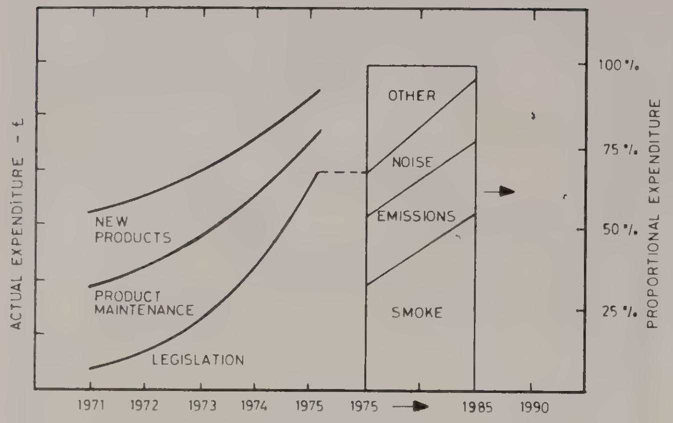

Fig. 8 Engineering R & D expenditure distribution 1970-1990

If this conflict between the immutable laws of physics and legal wishful thinking could be resolved, then a faster and more effective progress towards the ultimate goal of a truly ecological engine would result .

FUTURE PROSPECTS

The new combustion systems evolved during the investigations described here, demonstrated practical methods of pollution control for small heavy-duty "diesels", simply and at source, without significantly affecting their performance. Current legislation trends suggest that low emission levels may never have to be met outside N. America, and possibly Japan and Scandinavia. In Europe, where the EEC 72/80 regulation currently calls for CO and HC levels of about twice the CARB 1973 requirements but on a different cycle, NOx concentrations are not limited at all. Tighter smoke and odour legislation would appear more likely.

Although later builds of the "Squish Lip" system have consistently returned HC levels of around 1½ g/bhp.h on the 13 mode cycle and subjectively been agreeably free from odour, no practical way of achieving reduced opacity has been uncovered other than by degrading emissions. Clearly, much further work is required if divergent N. American and European legislation is to be met with a single engine specification. In the meantime, the various "Squish Lip" systems evolved are being tested under field conditions.

The energy crisis has coincided with a fuller realization that liquid fossil fuels are unlikely to be able to support planned consumption growth rates much beyond the next decade or two. Attention is already turning to shale and coal derivatives. By the end of the decade synthetic methanol, ethanol and coal derived liquid fuels could be supplementing the transportation fuel inventory. In view of this, the ability of the new system to handle a somewhat broader range of fuel specifications is considered relevant and is being pursued further.

The application of emission control features of the kind described should allow the development of "diesels" having firing pressures and rates of pressure rise, and hence structural weights, more nearly comparable with those of "gasolene" engines. Some scope for improving mechanical efficiencies has also been noted.

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Committee to be set up to review asbestos health risks

The Health and Safety Commission in agreement with Ministers concerned is to set up a committee to review health risks to workers and members of the public which may arise from exposure to asbestos.

Following consultations between Mr. Bill Simpson, Chairman of the Commission, and Dr. David Owen, Minister of State, Department of Health and Social Security and other Ministers, it was agreed that a general study for Government as a whole of the present situation on asbestos and health was needed.

Mr. Simpson will himself act as Chairman of the new committee whose membership will be announced in due course. Other interested Government Departments including the Central Unit on Environmental Pollution, will be closely involved in the work of the committee.

The committee will have the following terms of reference: "To review the risks to health arising from exposure to asbestos or products containing asbestos including:

- persons exposed at work;
- members of the public exposed to asbestos generated from work activities;
- members of the public exposed to asbestos from consumer products and from asbestos waste.

To make recommendations as to whether any further protection is required."

It is intended that the composition of the committee will reflect as wide a range of scientific, medical and practical expertise as possible, including representatives from both sides of industry.

The committee's terms of reference empower them to cover all risks from asbestos including its release into the working and general environment and either to satisfy themselves that safeguards are adequate or to make recommendations how improvements should be made. However, it is not proposed that the committee should duplicate work already in hand or completed by other Government Departments which fall within their terms of reference.

The Health and Safety Commission has responsibilities under the Health and Safety at Work etc. Act 1974 to protect people at work and also members of the public who may be affected by work activities, but, by agreement with Ministers, the Committee's remit is wider as it takes in all possible exposure to asbestos.

The findings of the committee will be published and considered by the Health and Safety Commission and relevant Ministers responsible for the matters reviewed.

BOOK REVIEWS

Air Pollution Control and Industrial Energy Production

by Noll, Davis and Duncan. Published by Ann Ardor Science. £11·95

The pollution received by the asmosphere from badly operated coal burning plant could be seen in the quantity of brown or black smoke emitted from chimneys. Now that more refined fuels and far improved combustion techniques are available it is rare to see such visible emissions although, sadly, it must be admitted that they do exist.

This state of affairs does not mean that air pollution problems have been solved any more than that the filtration of a glass of muddy water removes the organisms which are invisible. With this in mind therefore the efforts of the authors must be of value to those who appreciate the difference between CLEAR AIR and CLEAN AIR.

The fact that the book is based on information presented to a Conference on Air Pollution Control in the USA does not detract from its value but, rather, demonstrates the fact that industrial problems are distributed on a world-wide basis and must be treated as such rather than approached from the parochial point of view.

In the past, British research and engineering skills have offered much to the world at large and it is now timely that Britain should take note of work done in other countries particularly now that the cost of investigational work is so high.

The fact that standards of pollution control are different or are quoted on different bases should not detract the reader from the implications behind the actual numerical details. This book has made some attempt to assess problems in many industries and it will be seen that the problems have a common basis in most industries.

As the frontiers of pollution control in all its aspects are penetrated more deeply, so the methods of detection need to become more perceptive and, similarly the methods of control must be more rigid. In addition to the chemical effects of any pollutant, the particle size must be of importance: the book contains some practical advice in this respect. The subject is treated through particulate size reduction down to the problems and possible cures of odour production, mentioning the cooking of animal products and even feather cooking.

The importance of other aspects of various problems on the eventual control of air pollution is discussed and this illustrates the generality of the author's approach.

With the world-wide interest in Air Pollution matters and the increase in the number of research workers engaged in the problem it would be an impossible task to compile a book to be all embracing even in the summary of knowledge at any given time. Each chapter, therefore, has references to detailed work to which the reader may wish to refer. It may be agreed that this is modern text-book practice but in the present state of wide spread intensive work it is difficult to imagine a book which covers at present all the information in all its aspects.

The book is well indexed and approaches the problem on a practical basis and to those who wish to take a look at things which cannot normally be seen then this book could provide the peep-hole through to the other side of the fence. Certain arguments and discussions may be too involved for many readers in terms of chemical and physical effects but to the more academic mind the practical approach to problems in the steel, pulp and paper and chemical industries may seem to be equally unfamiliar.

When all is said and done it is the end result from the top of the chimney which determines the degree to which the atmosphere will be polluted and this book has made an honest attempt to assess the problems and find practical solutions.

H. Brown

The Evolution of Health and Safety in Mines

by Sir Andrew Bryan. Ashire Publishing Ltd. 192 pages. £5·90

This book represents a wealth of experience, painstaking research, and, above all, the ability to present the history of the evolution of Safety and Health in British Coal Mines in an informative and enjoyable manner. Potential readers should be forewarned—no matter how busy they may be, or however theoretical and uninteresting the title may appear, once committed to the early pages they will find the book extremely difficult to put down.

One would expect authenticity from a person who has risen to the heights in the Mining Industry, not only as Board Member of the National Coal Board, but as HM Chief Inspector of Mines; both Institutions with a concern for safety and health respected the world over.

It is appropriate that the book, which starts in pre-legislation days, ends with the work of the Robens Committee—a body instrumental in the formation of our current Health and Safety at Work Act 1974.

Covering as it does two centuries of Coal Mining, it tells of the occurrences and lessons we have learnt, all too often in the early days the hard way, and the steps taken to avoid them happening again.

G. G. Lambert

Handbook on Aerosols

edited by Richard Dennis—Technical Information Center, Office of Public Affairs, US Energy Research & Development Administration, pp 148. $8·50

A handbook ought to take the form of a dictionary or encyclopaedia rather than the form taken by this one. It is a collection of review papers of considerable merit but of enormously variable difficulty for the reader. Some parts are utterly obvious to anyone who is likely to use the volume, others require a long period of quiet study to make use of.

It is a useful book but is not arranged as well as it might be for reference purposes. Thus we have an index which refers to pages where one must search, not with confidence that one will find the subject treated. It is hit or miss: in some cases one is lucky, in others one finds a passing reference to the subject indexed. Thus although particle counters are referred to only on p 105-6, it is almost in passing and we are referred to the collected papers of J. Aitkin (Sci) 1923.

There are some useful tables at the end but many of them are at the level of those on the back of a school exercise book and should not clutter up an advanced technical manual of this kind. Some of the graphs of physical constants as a function of altitude have quite unjustified wiggles in them which are quite meaningless in practice because of geographical and seasonal variations.

The references are copious: but it is the job of a handbook to advise. Instead one has the impression that they set out to be comprehensive rather than discriminating, which doesn't help anyone these days.

R. S. Scorer

Industrial Odor Technology Assessment.

Edited by Cheremisinoff and Young. Anne Arbor Science, pp 493. £15·65.

The writing of such a book as this is a particularly difficult one in view of our lack of the precise nature of the chemical compounds responsible for the odour effect and, therefore, of their concentrations; consequently, in many cases, quantitative treatment is limited. Equally difficult is the presentation of a book really concerned with the application of chemistry and chemical engineering to particular problems. This is, however, one of the better ones of the Anne Arbor Series. It should stand comparison with the two Reports of the Working Party on the suppression of odours from offensive and selected other trades, published by the Warren Spring Laboratory, which completely outshine it in common areas, including the particularly important one of the applications of the various methods of small suppression. It is difficult to imagine for whom it will provide anything approaching a full appreciation. The stated aim of the book is for "expert, student or novice" in fields ranging from consultant to sewage works operator. Endeavouring to achieve this, the book is a mixture of elementary science representing merely a nuisance to the expert, and more advanced matter which will give only an adequate amount of knowledge and may be incomprehensible to the novice. On careful reading, such as would be required to make use of the content, the book is woefully bad. For example, on page 157, concerning a calculation on the volume of an absorbtion bed of activated charcoal, a figure of 0·7 appears out of the blue with no indication of meaning, source, units, or reference—this in a calculation set out in a fifth-form manner. The pressure drop is merely quoted for a velocity of 40ft/second with no data or reference to the size of the particles or other velocities, despite many other tables far too detailed to be of interest. The chemistry is weak, and it is alarming to read (p 301) that "Chlorine dioxide (ClO_2) is entirely harmless in aqueous solution". One trusts that this is not the drink to which the reader might be driven.

Having said this, and bearing in mind the difficulty of the task, there is much useful information in the book which requires reading with a good knowledge of the subject in mind; for its main failing is lack of critical comment of the various solutions described. The book gives the imression that one takes one of the methods, applies somewhat superficial chemistry and chemical engineering and the problem is "controlled"—an undefined solution throughout. Chemical analysis can apparently identify the odorous components; atmospheric diffusion is treated, quoting the standard formulae sources with no criteria of the accuracy for the problem in hand; standard absorber-design basic theory is applicable; gas phase reactions, e.g. ozone and chlorine, cure the problem.

Compare the book with the Warren Spring Reports or really expert knowledge—the odour world is not like this. However, there being much good material in this book, it would be worthwhile as part of a sizeable library, but it must not be assumed that its study will make a non-expert into an expert—it could make a pseudo-expert.

B. Leadbeater

BSI PUBLICATIONS

Safe Transport of Radioactive Materials

In order that the high levels of safety laid down by the International Atomic Energy Authority (IAEA) governing the transport, handling and packaging of radioactive materials might easily be complied with BSI, first published a standard on the subject in 1965. Part 1 dealt with materials other than large radioactive sources and fissile materials and a year or so later Part 2 covered fissile materials and large sources. These standards were vital because they specified design principles and test requirements not covered in IAEA regulations. Now, by continuing to play a leading role in this field, BSI has been able to replace these old standards with a new authoritative guide for all concerned in the design and shipment of packages of radioactive materials, taking full account of the latest international regulations. The two parts are now superseded by one retitled version—BS 3895 Guide to the design testing and use of packaging for the safe transport of radioactive materials.

For many years various BSI committees have been involved in standards work on radioactive materials, and they have always been active in co-operating in international work. In this way, BSI has provided a forum for expert discussion of proposed amendments to the IAEA regulations for the safe transport of radioative materials whether originating in the UK or abroad. Through this forum the experts' views have been made known to the official government body responsible for transmitting the UK viewpoint to the IAEA.

UK regulations on transport of radioactive materials by road are ahead of most other countries' national regulations, as they reflect fully the 1973 edition of the IAEA regulations. A great deal of work has been carried out in the UK on the testing of packages and of particular importance has been the 9m free drop test and the associated 800°C thermal test.

With all this expertise gathered in one guidance document, users will find it a useful tool in ensuring that package designs meet both national and international requirements.

Copies of BS 3895 are available from BSI Sales Department, 101 Pentonville Rd, London N1 9ND. Price £7·50 including postage.

Lead in Petrol

The recently agreed European standard for determination of lead content of gasoline has been published as a British Standard. It is of particular significance because of the forthcoming European Directive concerning limits for lead content in petrol, which is intended to limit any increase in the overall emissions of lead from motor vehicles.

The standard, which in Britain is published as BS 5290 (EN 13) Determination of lead content of gasoline (volumetric chromate method) will be specified in the directive and subsequently referred to in British legislation.

The method of test is based on a well established procedure which has been in use for a considerable number of years for the estimation of lead in gasoline and is based on the corresponding methods of the American Society for Testing and Materials (ASTM) and those of the Institute of Petroleum. It is technically identical with each of these except that the scope has been extended to cover the range of lead encountered in aviation gasoline.

Two other European standards in this field have also been published as revisions of British Standards although they are not connected with directives. They are BS 4348 (EN 5) Determination of existent gum in fuels by jet evaporation and BS 4450 (EN 7) Determination of ash from petroleum products. Both are technically identical with corresponding ASTM tests.

BS 4348 describes a method for the determination of existent gum in fuels by evaporation under steam jet and also includes a method for the determination of unwashed gum in gasoline.

BS 4450 describes the determination of ash from petroleum products by heating in a muffle furnace to a temperature between 700°C and 800°C for ten minutes or more. It is restricted to petroleum products not containing ash forming additives and is therefore not applicable to extreme pressure oils or greases.

The texts of all three standards are the official English editions of the corresponding European standards and have equal authority with the official French and German texts as European Standards.

Copies of all three standards are available from BSI Sales Department, 101 Pentonville Road, London N1 9ND. Prices: BS 5290 (£2·40); BS 4450 (£1·50); BS 4348 (£2·40). Including postage.

Introducing WHO

Geneva, World Health Organisation, 1976 (ISBN 92 4 156049 5). 88 pages. Price: Sw.fr 10. Mail Orders to PO Box 569, London SE1 9NH

It is almost 30 years since the World Health Organisation came into being on 1st September 1948. Since then, very full information on its activities year by year has been made available in the form of Annual Reports of the Director-General, of which 27 have so far been published. However, there has until now been no concise source of information about WHO's activities. The purpose of this profusely illustrated brochure of 88 pages, published under the title "Introducing WHO", is to fill a gap by providing a compact source of information on what WHO is, what it does, and how and why it does it. As the WHO Director-General, Dr Halfdan Mahler, states in a foreword, "WHO is a public organisation and belongs to its many Member countries and their people", and the brochure has as far as possible been written in non-technical language with a view to facilitating an understanding of WHO's work not only by members of the health professions but also by the general public.

In a first chapter on "Origin and development of international health co-operation" the history of international health work from the first International Sanitary Conference in 1851 to the coming into force of the WHO Constitution in 1948 is briefly sketched. There follow chapters on "Nature and structure of WHO", "Scope of activities", "Prevention and control of specific diseases", "Basic activities" "Methods of work", "Building and budgeting for the programme", "Administrative support", "WHO within the United Nations system", and "WHO—the changing emphasis". The volume is completed by three annexes containing respectively notes for further reading, a description of WHO publications, and the addresses of the various WHO offices.

The emphasis throughout is on explaining not only what WHO does but also the nature of the problems with which it is concerned, and the many illustrations are accompanied by detailed legends which supplement the information contained in the main text.

New additions to the NSCA Library

Alternative fuels for motor vehicles. J. K. Duxbury. Dept of Industry, Science and Technology Abroad Series, GER 134. Aug 1975.

Chlorofluorocarbons and their Effect on Stratospheric Ozone. Pollution Paper No. 5. DOE, Central Unit on Environmental Pollution. HMSO, 1976. 71 pages. £1.

Control of Pollution Act 1974. Implementation of Part III—Noise. Circular 2/76 DOE, 3/76. Welsh Office. HMSO 1976. 55p.

Electric Vehicles in the United States. J. McAuley. Dept of Industry, Science and Technology Abroad Series. USA 75/2. July 1975.

The Estimation of Pollution Damage. P. J. W. Saunders. Manchester University Press. April 1976. 126 pages. £6·95.

First Annual Report and Accounts 1974/5. National Water Council. 1975. HMSO. 77 pages. £1·75.

Focus on Environmental Geology. 2nd Ed. Ronald W. Tank, editor. Oxford University Press, 1976. 538 pages. £5·00 (paperback).

Hexavalent Chromium Pollution in Japan. P. E. Roe. Dept of Industry, Science and Technology Abroad Series, JAP 96, September 1975.

Introducing WHO. World Health Organisation, Geneva, 1976. 88 pages. Sw.Fr.10.

Methods for the Determination of Hydrocarbons in the Atmosphere. Concawe Report No. 3/76. Stichting Concawe, The Hague. March 1976.

Review of the Water Industry in England and Wales. A Consultative Document. DOE, Welsh Office, Ministry of Agriculture, Fisheries and Food. 1976.

River quality and discharges of sewage and industrial effluents. River Pollution Survey of England and Wales. Updated 1973. DOE, Welsh Office. HMSO 1975. 62 pages. £2·60.

South Africa's Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1975), as amended by the Atmospheric Pollution Prevention Amendment Act, 1973 (Act 17 of 1973).

Transport Policy. Consultation Document. 1976. HMSO. Vol 1, £1·35, Vol 2, £1·70.

Bonfire Leaflet. The Society's new leaflet ' Garden Bonfires ' is available free of charge for small quantities. Bulk supplies can be purchased at £2·50 per 100 copies + p & p from NSCA.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Spring 1976)** *which gave the position up to* **31 December 1975.** *They now show changes and additions up to* **31 March 1976.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

As from 23 September 1974, the distinction between "black" and "white" areas has been discontinued. Because of this, the table showing the smoke control position in regions of England has been temporarily discontnued.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

No new Smoke Control Orders have come into operation in England during the three months under review.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern
Darlington No. 14 (South); Middlesbrough No. 21 (Nunthorpe) and No. 22 (Acklam Road/Ayresome, Green Lane).

North Western
Blackburn Nos. 16 and 17; Halton No. 16; Manchester (Cheetham); Preston Nos. 34-36; Rochdale No. 3 (Archer Park, Middleton); Rossendale No. 1; South Ribble No. 3; Tameside (Ashton No. 17).

Yorkshire and Humberside
Doncaster No. 1; Kirklees Nos. 14 and 15 and No. 18 (Huddersfield).

West Midlands
Stoke-on-Trent No. 31; Walsall No. 24 (Pleck).

East Midlands
Erewash No. 1 (Petersham, Long Eaton); High Peak (Glossop No. 8); Northampton No. 13; South Kesteven D.C. No. 2 (Grantham No. 24).

London Boroughs
Bromley No. 25; Kingston-upon-Thames No. 25; Newham No. 14; Waltham Forest Nos. 27 and 28.

South Eastern
Brighton No. 2; Dartford Nos. 14 and 15; Gillingham No. 8; Luton No. 13; Milton Keynes No. 2 (Bletchley No. 5); Watford No. 14 (Paddock) and No. 15 (Central).

South Western
Exeter (St. James No. 1).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern
Carlisle Nos. 1-4; Hartlepool No. 31; Langbaurgh No. 2 (Hunters Hill, Guisborough); Stockton-on-Tees No. 6 (Cowper Bewley Village), No. 7 (Roseworth North) and No. 8 (Hilton Mattby and Ingleby, Barwick).

North Western
Blackburn No. 17; Bolton No. 5 (Bolton B. No. 51); Burnley B.C. No. 1; Halton No. 16; Liverpool No. 28; Preston Nos. 34-36; Tameside (Ashton No. 17); Trafford (Hale No. 6).

Yorkshire and Humberside
Doncaster No. 5 (Hexthorpe) and No. 6 (Hyde Park/Belle Vue); Wakefield No. 1 (Hemsworth) and No. 10 (Pontefract).

West Midlands
North Warwicks No. 2; Nuneaton No. 15 (Chilvers Coton).

East Midlands
Bassetlaw (Worksop No. 5-Valley Road); Erewash No. 1 (Petersham, Long Eaton); Gedling No. 4; South Kesteven D.C. Nos. 3-7.

London Boroughs
Merton No. 32.

South Eastern
Gillingham No. 8; Gravesham No. 2; Guildford No. 4; Slough No. 17; Southampton No. 17; Stevenage No. 4.

NORTHERN IRELAND

NEW SMOKE CONTROL ORDER IN OPERATION

Antrim D.C. No. 4 (Var).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Belfast C.C. No. 13; Craigavan B.C. Nos. 5 and 6.

SCOTLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Strathkelvin District (Bishopbriggs North No. 5); City of Edinburgh District (Colinton No. 3).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

City of Edinburgh District (Liberton No. 1).

WALES

NEW SMOKE CONTROL ORDER IN OPERATION

Wrexham Maelor B.C. No. 1.

SMOKE CONTROL ORDERS WITHDRAWN

North Western
Sunderland Nos. 14 and 15; Wirral-Birkenhead No. 20 (Woodside) and No. 21 (Mersey).

London Boroughs
Bromley No. 27.

SMOKE CONTROL AREAS

Progress Report

Position at 31st March 1976

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).
** Amended to comply with DOE for Northern Ireland figures*

	England			Wales			Scotland			Northern Ireland		
Smoke Control Orders Confirmed prior to 31.12.75	4,611			21			249			66		
Acres		1,502,370			2,912			134,502			16,087	
Premises			6,661,601			10,499			570,652			43,266*
Smoke Control Orders Confirmed (31.12.75-31.3.76)	38			—			1			—		
Acres		23,693			—			2,031			—	
Premises			64,862			—			2,122			—
Totals	**4,649**	**1,526,063**	**6,726,463**	**21**	**2,912**	**10,499**	**250**	**136,533**	**572,774**	**66**	**16,087**	**43,266**
Smoke Control Orders Submitted (31.12.75-31.3.76)	40			—			—			3		
Acres		26,193			—			—			267	
Premises			52,549			—			—			3,015
Grand Totals	**4,689**	**1,552,256**	**6,779,012**	**21**	**2,912**	**10,499**	**250**	**136,533**	**572,774**	**69**	**16,354**	**46,281**
Smokeless Zones (Local Acts) in Operation	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

Mr. Richard Hollingdale, West Lancs. commercial manager, retires

Richard Hollingdale, commercial manager of the West Lancs. area of North West Gas since 1971, has retired after 24 years in the gas industry.

Mr. Hollingdale, of Lytham St. Annes, Lancashire, worked for many years in the coal industry in South Wales before joining North West Gas as deputy coke officer in 1952. He was manager of the Barry branch of Coal Distributors (South Wales) Ltd. (1938), manager of the coke department of Coal Distributors (1949) and marketing manager (coke) for the National Coal Board (1951).

Mr. Hollingdale was appointed coke officer for North West Gas in 1959. He was also appointed purchasing officer (raw materials) in 1968 and was responsible for the purchase of coal, naphtha, fuel oils and other products required in the manufacture of gas. He was appointed commercial manager of West Lancs. in 1971.

Mr. Hollingdale is an honorary life member of the North Western branch of the Coal Industry Society and honorary treasurer of the National Society for Clean Air.

Asbestos dust and cancer of the larynx

The Cancer Research Campaign has made a grant of £2,098 for a period of six months to March 1976, to Dr. Muriel L. Newhouse of the TUC Centenary Institute of Occupational Health, London School of Hygiene and Tropical Medicine, to enable her to complete a research project into the possible connection between asbestos dust and cancer of the larynx.

Exposure to asbestos dust is already known to be a cause of fibrosis of the lungs, cancer of the lung and of malignant mesothelial tumours of the pleura—that is the tissue of the lung and similar tissue lining in the abdominal cavity. Recent work has also suggested that asbestos exposure is an important factor in causing cancer of the larynx.

In order to confirm this work, careful occupational and residential histories have been taken from patients at the Institute of Laryngology and the Ear, Nose and Throat Department of the London Hospital. These patients were interviewed on the day of admission to hospital prior to definite diagnosis.

This work has progressed well and more than 450 interviews have been conducted and a pathological diagnosis recorded. About one-fifth of these patients have laryngeal cancer, a further proportion having possibly premalignant conditions. It appears that a history of asbestos exposure may be more common in these two groups of patients than in patients with non-malignant disease of the larynx.

In order to verify the diagnoses which have been made by a variety of pathologists, Dr. Monica Gregory of the Institute of Otolaryngology has assisted the investigation by reviewing the histology.

The collection of data is now complete and a careful analysis is being made, not only of the importance of asbestos as a cancer producing factor but also of the role of cigarette smoking and alcoholic beverages as possible cocarcinogens.

The Cancer Research Campaign is the largest supporter of research into cancer, including leukaemia, in the United Kingdom and in 1974 awarded grants totalling over £4½ million.

ATMOSPHERIC LEAD POLLUTION
Some Observations

by
JOHN GRAHAM POLLITT. M.Sc., M.E.H.A.
Environmental Health Officer, City of Salford

A paper presented to the North West Division of the National Society for Clean Air at Preston on March 2nd 1976

INTRODUCTION

The assault on our environment by atmospheric pollutants has been known for many centuries. It is, however, only in the pollution conscious and technologically minded society of more recent years that attention has been directed and drawn to the problem and potential dangers of the atmospheric heavy metal burden. The most widespread, and consequently perhaps the most immediately important, of these heavy metal pollutants is lead.

Whilst there is not a single piece of evidence to prove any deleterious effect of atmospheric lead on human health, concern exists over possible chronic effects and a further increase in the lead content of the atmosphere is obviously considerable.

In consequence the monitoring of ambient atmospheric lead levels becomes a necessity.

Two surveys have been carried out in the City of Salford during the latter part of 1974 and the early part of 1975. The first concerned the degree of lead pollution in the atmosphere, and the second that in roadside dusts.

Lead in the atmosphere

The sampling of lead from the atmosphere requires no radically new or expensive equipment, the utilisation of volumetric apparatus being quite satisfactory.

There are many different types of filter medium available, each with a varying degree of efficiency. For the purposes of the study carried out in Salford, Whatman number 1 filter papers were used. This particular type of filter paper has been criticised in the past as having a dubious efficiency in the collection of sub-micron particles, but very similar results to those recorded by millipore filters in the same area have been obtained. In the light of this information the use of Whatman number 1 papers would appear to be acceptable in this instance. (Turner, Warren Springs Laboratory, pers. comm. 1975.)

A total of 243-24-hour samples were taken from 13 sampling points over a six-month period from the 2nd October 1974 to the 30th March 1975. One sample being taken every eight days at each sampling station, the method of analysis being by atomic absorption spectroscopy.

The determination of specific atmospheric pollution sources is vital, for the greatest improvement in air quality is achieved by applying emission controls to the sources that contribute most to the particular problem.

Research has shown that automobiles are the major culprits, indeed the Department of the Environment state that automobile exhausts may account for 90% or more of the total lead burden in some areas.

One might therefore expect the degree of pollution to show some correlation with the day of the week, for traffic flows are known to increase from between 5% and 10% on Fridays, but this did not manifest itself.

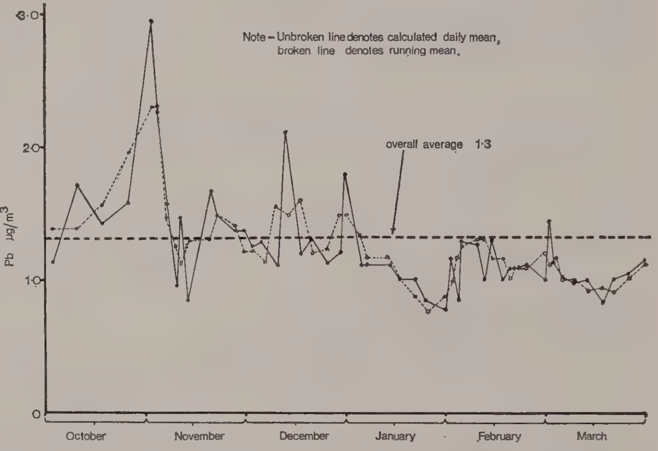

Fig. 1 Mean recorded lead concentrations in Salford

Figure 1 shows the recorded daily averages over the entire sampling period together with the running average which is calculated from the preceding and following daily averages. The running average has the effect of reducing the pictorial impact of extreme measurements and gives a picture more indicative of the average over a time period instead of on one day only.

Both types of daily averages show the winter period to be full of uneven peaks, the recordings then gradually levelling out into a more even pattern. The fact that this levelling out occurs, noticeably below the overall average, would suggest some seasonal variation, which is expected since the emission of this pollutant is greater in the winter months due to the presence of more motor vehicles. (Waller, Commins & Lawther 1965.)

Details concerning wind direction, wind speed, humidity, maximum and minimum temperatures and rainfall for the six-month sampling period were supplied by the meteorological office, but no significant correlations between them and the recorded lead levels could be found. The influence of wind direction on the monitoring of lead emitted from automobile exhausts on a road in a rural setting can usually be seen (Motto, Daines, Chilko & Motto 1970), but it would seem from the preliminary observations of the figures recorded in Salford that the effect of wind direction on the atmospheric monitoring of lead in an urban area is attenuated to a large degree. This is probably due to both the presence of buildings, causing turbulence, and by the presence of the inevitable complex matrix of roadways, which can be considered as pollution sources, surrounding the sampling equipment.

The variability of the results recorded at each individual station is of great interest, for when this variability is compared it is possible to see to what extent the lead emitted from vehicles on both major and minor roads is homogenised in an urban environment.

Figure 2 shows each mean plus and minus two standard errors. This portrays the expected ranges into which future averages from the individual monitoring stations should fall.

It can be seen that, as was expected, the sampling point on the busy Regent Road has a higher mean than the other stations, although the ranges of the sampling points at both Trinity Centre and Cleveland House would appear to go higher. In order to assess the difference between the variability of the recorded levels at the individual monitoring stations the figures were subjected to statistical ' t ' tests.

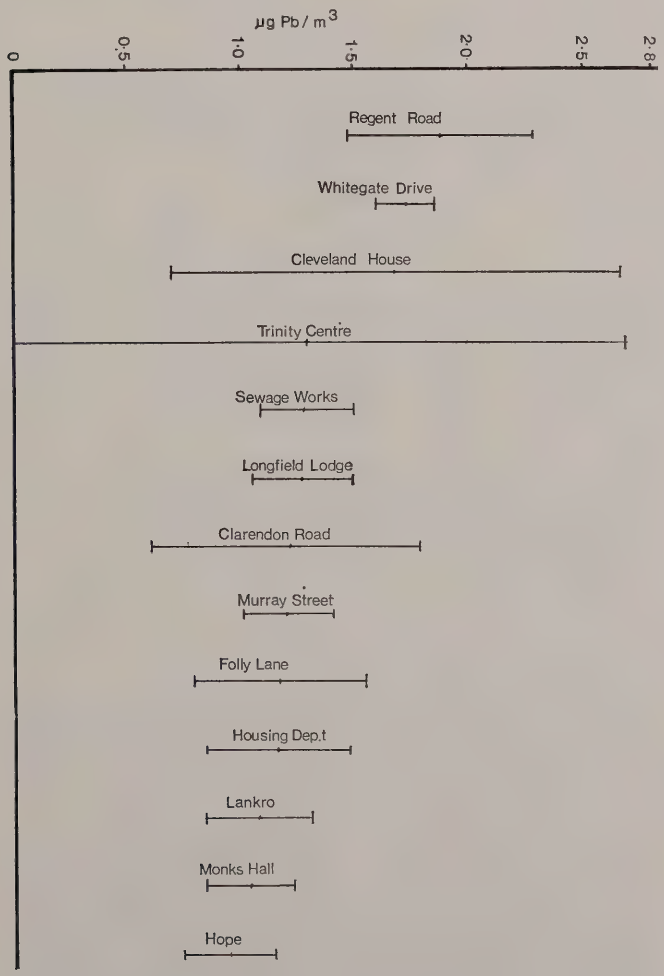

Fig. 2 Atmospheric sampling stations, expected mean ranges ($\bar{x}$ ±2 SE)

A perusal of the results of these tests enabled the categorisation of the different monitoring stations into four reasonably distinct groups. The first group contains those stations whose results were consistently high in comparison with the others, the second contains those stations whose results were consistently moderate, the third contains those whose results are consistently low, and the final group those whose results are so variable that they are not significantly different from the other three groups. See Figure 3.

The monitoring point at Regent Road would be expected to be in the high category due to the fact that the intake point faces directly onto a major road. The presence of Whitegate Drive in this group is not immediately apparent but it may simply be included by reason that in this instance too few samples (four) were obtained to be of statistical value.

CONSISTENTLY HIGH	CONSISTENTLY MODERATE	CONSISTENTLY LOW	VARIABILITY WIDE
Regent Rd.	Sewage Wks.	Housing Dept.	Trinity.
Whitegate Dr.	Longfield Lo.	Folly La.	Cleveland.
	Murray St.	Lankro.	Clarendon Rd.
		Monks Hall	
		Hope Hosp.	

Fig. 3 Variability classification

Those stations contained in the groups of consistently moderate and consistently low readings would seem virtually the same from a positioning point of view. It has not been possible to discover why a differentiation occurs between these particular stations, but the unknown effects of buildings on wind direction must here be suspected as the cause.

The last category, that containing those stations with a wide variability of lead recordings, is perhaps the most interesting. The presence of Cleveland House sampling station in this group is perhaps again explained by the low number of samples taken (three). Trinity Centre may be contained in this particular group by reason of the large number of vehicles which park along the street onto which the sample entry point is positioned. Whilst this monitoring station is situated well away from a major highway, the presence of vehicles which stop, start and accelerate away may increase the lead level recordings. However, the presence of the Clarendon Road site in this category implies the influence of a factor which is, as yet, not apparent—a sure indication that much more research into the variability of lead levels in an urban environment is required.

The overall mean of the atmospheric lead recordings taken in Salford during this study is similar to that experienced in cities of comparable population in the U.S.A.—see Figure 4.

The levels recorded in this survey cannot be strictly called safe, due to our lack of knowledge concerning the lead poisoning threshold, but levels such as these were discussed by the Surgeon General in his report to the U.S. Congress (reported by Waller, Commins & Lawther, 1965). The Surgeon General considered that "The maximal atmospheric lead levels currently observed have been

SITE	LEAD -MEAN CONCENTRATION $\mu g/m^3$
U.S. REMOTE AREA	0·12
U.S. CITIES < 0·1 million pop.	1·2
0·1 – 0·5	1·3
0·5 – 1·0	1·5
1·0 – 2·0	1·6
> 2·0 except Los Angeles	2·5
LOS ANGELES	4·4
SALFORD	1·25

Fig. 4 Atmospheric lead in comparison

much too low to produce clinical evidence of lead poisoning . . . but . . . there are many questions still to be answered."

Only further research can answer these questions.

The lead content of roadside dust

The collection and analysis of roadside dusts has many limitations and consequently is open to heavy criticism.

Perhaps the greatest criticisms directed at lead in dust surveys relate to rainfall and the act of street cleansing. The effect of rainfall on the lead content of street dusts has been shown by Turner, Davies & Richardson (1971) to be negligible and they suggest this to be consistent with the acknowledged fact that the lead compounds present are predominantly of a very low solubility. The interference of street sweeping on the lead content of dust can surely also be considered as negligible then, as the water used will have little washout effect on the lead, and the actual sweeping operation will only reduce the total amount of dust present.

However, an attempt to correlate the lead concentrations of roadside dusts with the ambient atmospheric lead concentration must surely reveal very little, for whilst it seems reasonable to assume that the bulk of the lead in dust was at some time airborne, it is obvious that many of the lead particles found in roadside dusts and emitted from motor vehicles would be too large and heavy to remain in suspension for very long, and consequently would not influence any recorded atmosphere measurements.

It has, however, recently been claimed by Day, Hart & Robinson (1975) that lead contained in dusts may considerably increase a child's daily lead intake by the accidental ingestion of dirt and dust from their surroundings in the course of their normal everyday activity. This would suggest a need for the monitoring of dust lead levels.

The survey carried out in Salford was intended not only to assess the amount of lead present in roadside dusts taken from differing types of areas, but also to provide an indication of the variability of lead concentrations in dusts sampled in close proximity to each other.

The samples were taken from 20 roadside sites, five samples being taken at a maximum distance of approximately 15 metres from each other at each site.

Five types of site were selected, the first type experiencing heavy amounts of traffic, the second experiencing moderate amounts of traffic, the third experiencing light amounts of traffic, the fourth experiencing light amounts of traffic in a rural setting, and finally a site in close proximity to a point source lead emitter was sampled in order to draw a comparison. It is indeed unfortunate that traffic counts were not available, local knowledge being consequently used out of necessity.

The samples were collected on the same day by the same people in order to obtain uniformity of collection. All of the samples were taken from asphalted surfaces where dust had gathered. Whilst it has been shown by Turner (1971) that very little of the lead content of roadside dust is attributable to the use of lead chromate paint in the form of yellow parking restriction lines, these were carefully avoided. Care was also taken in the avoidance of extraneous matter such as leaves and cigarette stubs. The method of analysis was by atomic absorption spectroscopy.

Site	Type	Sample				
		A	B	C	D	E
Regent St.	Heavy Traffic	520	460	645	410	565
Regent Rd.		1000	700	910	770	750
Manchester Rd.		1050	970	550	1360	990
Bolton Rd.		750	515	965	300	1265
East Lancs. Rd.		1220	1070	1810	4090	1890
Weaste Lane	Moderate Traffic	835	325	250	390	435
Swinton Hall Rd.		465	495	530	645	580
Old Lane		1020	530	565	210	200
Silver St.		645	135	240	235	165
Worsley Rd.		770	1050	1295	2065	1010
Shawcross St.	Light Traffic	855	1395	1450	1440	1035
Maple Ave.		245	525	65	150	245
Hafton Rd.		190	90	260	105	210
West Rd. E.		35	120	150	495	315
Branksome Dr.		5310	765	70	400	3340
The Avenue	Rural Area	10	10	15	80	10
Astley Rd.		115	230	45	100	90
New Moss Rd.		150	105	150	265	125
Eccles Cemetery		180	155	25	50	55
Lumns Lane	Point Source	2805	2110	1495	49960	27525

Fig. 5 Lead in dust—recorded measurements 28th July 1975 (p.p.m.)

The recorded lead in dust levels are shown in Figure 5, a perusal of these results reveals several interesting, if not startling anomalies.

The supposition expressed by the Environment Protection Unit of the City of Birmingham (1975) that lead is deposited with dust reasonably uniformly would seem to be dismissed. The variability of samples taken from the same roadway, in very close proximity to one another is at a very high level, the sites at Branksome Drive and on Lumns Lane being the most obvious cases. Lumns Lane sampling site was close to the point source lead emitter and would be expected to have high lead in dust levels, but that at Branksome Drive which is a quiet residential street, gave us one particular lead level which was higher than any of those taken from a busy main road.

Indeed if we look at Figure 6 which portrays the expected ranges of future averages from the sample sites, it is immediately apparent that either we are wrong to presume that motor vehicle traffic is the main culprit of atmospheric lead pollution, or the variability of lead concentrations in dust is too great for us to arrive at meaningful conclusions.

The variability of the samples obtained from this survey would suggest that owing to the obvious lack of consistent deposition and accumulation of lead over even a small area, it is not possible to obtain much useful information regarding lead levels in road dust, excepting the level existing in the small area from which an individual sample is swept.

A biological monitoring possibility

The value of biological monitors of pollution has long been known. A classic example perhaps is the relationship between lichens and SO_2 in the atmosphere.

When a pollutant is monitored by chemical methods the results obtained relate directly to the degree of pollution only at the time of sampling. A biological monitor indicates the degree of pollution over a period of time, indeed certain pollutants can reach such a concentration as to prohibit the existence of an entire sensitive species population.

In order to find a biological monitor of atmospheric lead levels we must first realise that the species chosen must fulfil certain criteria.

1. They must be capable of absorbing atmospheric lead in quantifiable amounts.
2. They must be in such a plentiful supply as to ensure an unbiased random sample.
3. They must be relatively easy to catch, again to ensure an unbiased sample.
4. They must not be subject to huge doses of ingested lead.
5. The method must be inexpensive.

The chosen species must therefore be one which lives in close proximity to man in his urban environment, it must be of a size large enough to absorb recognisable amounts of lead, their food must not be heavily lead tainted, and they must cost nothing to maintain.

The animals which fulfil these criteria are the common urban pests, mice, rats and pigeons. The feral pigeon is less likely to ingest lead in its food than mice or rats, both of which have been known to gnaw through lead piping, and consequently provides us with a suitable subject species.

Pigeons are pests in the urban environment, fouling buildings, damaging roofing and capable of causing bronchitis or psittacosis. As nuisances they are captured as a normal procedure by the pest control sections of most urban area administrations, and consequently sample collection costs may be regarded as negligible.

Blood lead levels are often taken, or misinterpreted, to be a crude indication of the total body burden of lead and of the amount to which exposure has occurred in a general way. However, repeated samples taken over a period of time may show substantial alteration in the lead concentration when it does not seem likely that the total body burden has undergone much change.

Tansy & Roth (1970) have shown that there was no significant difference between the blood lead levels of pigeons living in the country and those living in the urban environment. They discovered, however, that the more stable bone tissues showed a significant difference in lead concentrations between the two types of population.

In order to carry out a preliminary assessment of the degree to which lead might be found in the bones of pigeons in Salford, five pigeons were captured by the Pest Control Section of the Environmental Health and Control Department.

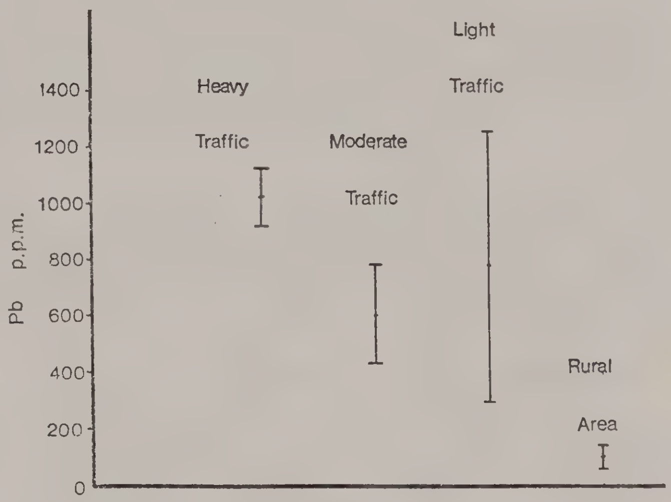

Fig. 6 Dust samples, expected mean ranges ($\bar{x}$ ±2 SE)

Bone samples were taken from each bird, the radius and ulna from both wings, and analysed by atomic absorption spectroscopy.

The recorded levels of lead varied between 44 and 101 p.p.m. of bone. These recordings reveal the lead concentrations to be easily measurable and although lower than those obtained by Tansy & Roth (1970) in Philadelphia (some bone lead levels were as high as 200 p.p.m.) they enable us to find expected mean ranges, if the mean of future samples do not fall within the range then it is possible to assess a rise or fall in atmospheric lead levels.

The value of urban pigeons in this role might ultimately be that they do not possess a source of preventative or curative medicine beyond that of their natural defences. Therefore, an abnormally high incidence of specific pathophysiological problems in a given pest population may serve as an early warning to the human population that cohabits with it. This type of relationship has been used in the past when, for example, coal miners depended on canaries.

The fact that lead is an accumulative substance means that the older the bird the greater the lead level. Difficulties may be encountered therefore in age differentiation, but this may be overcome to some extent by assessing the age of the subject by bone ossification.

Tansy & Roth (1970) further found that lead is a regularly occurring constituent of fledgling pigeons. This is suggestive of parent/egg lead transference.

In an attempt to establish whether or not this transference took place, two eggs were taken from the same nesting site as the sampled birds. The eggs were again analysed (white and yolk) by atomic absorption spectroscopy and were found to contain nine and six parts per million lead respectively.

Although these amounts are expectedly smaller they are still large enough to be recognisable. The use of pigeon eggs in the role of monitoring atmospheric lead levels could be valuable, because the ages of the samples are more or less constant.

CONCLUSIONS

(a) Lead in the atmosphere

The overall recorded mean value of $1\cdot3\ \mu$g Pb/m^3 falls below the limit suggested by the E.E.C. draft directive on Biological & Air Quality Standards for Lead of 2 μg Pb/m^3. However, with the continuing increase of motor traffic the atmospheric lead level is expected to rise in future years, despite the lowering of the lead/petrol ratio.

(b) Lead in roadside dust

The paucity of information obtained from this survey, other than that showing lead not to be deposited uniformly with dust, has led the author to recommend to his local authority that this method of monitoring lead in the environment be discontinued.

(c) A biological monitoring possibility

It is obvious that no definite statement on the importance of both pigeons and their eggs, in the role of atmospheric heavy metal pollutant monitors, can be made at the present time owing to the lack of research carried out in this field. The author has, however, recommended to his local authority that more background knowledge should be obtained and that a specific sampling programme be organised, in order to assess the impact and potential of feral pigeons, which have hitherto been regarded as having a nuisance value only.

It is important to balance the expense, in terms of human and technical resources, of monitoring a pollutant particularly in the present economic climate, against the value of the resultant data. In a situation such as that experienced with lead it is often impossible to estimate the costs and benefits of a monitoring programme until the research is actually completed.

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NEWS FROM THE DIVISIONS

LONDON, SOUTH EAST & CENTRAL SOUTHERN

Visit to the London Brick Co, Stewartby, Bedford

A small party of members and representatives visited the above works on 6th May 1976. After coffee the programme commenced with an introductory talk illustrated by slides on the method of brickmaking and the history of the works by Col. R. J. Harvey, the Public Relations Officer. This was followed by a tour of the works which enabled visitors to observe the various stages of brickmaking in operation.

Lunch was provided by the London Brick Company and the afternoon was devoted to visiting various sections of the research laboratories.

The visit, which proved to be extremely interesting and informative, was very much appreciated by all the members of the party.

B. C. Upton
Hon. Secretary

EAST MIDLANDS

The Annual General Meeting of the East Midlands Division was held on 22nd April, 1976, at the Guildhall, Lincoln.

On arrival at Lincoln some 60 members were served with coffee by kind invitation of the Mayor and City Council. Duly refreshed, they boarded buses which took them to Lincoln Cathedral where they were taken round in two parties, one being conducted on a general tour whilst the second, for the more energetic, included access to the roofs, to the bell room and on to the roof of one of the towers from which the countryside around Lincoln was visible for miles in all directions.

Our thanks are due to the guides and the one who conducted the second party, of which I was a member, was a man obviously devoted to the Cathedral and very well versed in its history and construction. His enthusiasm added immensely to the visit, and members were surprised to learn that at 72 years of age he daily went halfway up the tower to the bell room to wind the clock—a matter of hundreds of revolutions of the winding handle.

An appeal notice outside the Cathedral referred to the effects of frost, rain and pollution upon the stonework, so that there were technical overtones as well as interest in the building itself.

Following the visit members enjoyed a buffet lunch at the City Hall, again by kind invitation of the Mayor and City Council. The Mayor and Mayoress, together with the Sheriff and his Lady honoured us with their presence at the lunch.

The Annual General Meeting was held in the afternoon in the historic Guildhall and commenced under the Chairmanship of Mr. J. Jones, City Environmental Health Officer for Lincoln. The meeting was attended by the Civic Party and the proceedings commenced with a Civic welcome by the Mayor (Coun. F. T. Allen) who said that he was pleased to welcome the Division to Lincoln, since although the City had been in membership since the inauguration in 1949, it was only the second time there had been a meeting at Lincoln and certainly this was the first time someone from the City had been Chairman of the Division. Coun. Allen also voiced his personal concern with Clean Air, having been a member of the Health Committee for most of his eighteen years as a Councillor and Chairman of the Committee when Lincoln was a County Borough. In expressing the hope that members had enjoyed their visit to the Cathedral the Mayor said that Oliver Cromwell was by no means to blame for all the damage, and there was ample evidence of the effects of atmospheric pollution on the stonework and carvings. Referring to the large area covered by the East Midlands Division and the Individuals, Local Authorities and Industrial Organisations included in the membership, the Mayor concluded by saying that the City was pleased to be host to such an important body.

The Mayor was suitably thanked by Coun. Cashmore for his very warm welcome to the City and for the facilities and hospitality which had been afforded the Division by the City of Lincoln on this occasion.

Mr. E. F. Raven, Honorary Secretary, said that the proceedings of the Division had been well reported in the Journal "Clean Air" and he did not propose to go through them again in detail. Reference was made to the work of the Divisional Council and note was taken of the fact that Mr T. Henry Turner had been made a Vice-President. The Secretary also said that he felt the Society was right to concentrate more on the noise aspects of the environment. Having thanked the Chairman the Honorary Auditor and the Scrutineers Mr. Raven said he felt that particular reference should be made to the service of Coun. Mrs. E. E. Stewart of Corby District Council, and Coun. C. E. Holland of Ashfield District Council (a past Chairman of the Division) both of whom were standing down from the Divisional Council. The meeting agreed to record appreciation of the service of both Coun. Mrs Stewart and Coun. Holland.

The Secretary reported on the Income and Expenditure for the year ended 31st March, 1976.

Under the rules of the Division the Vice-Chairman Coun. W. R. Cashmore of Peterborough succeeded as Chairman. In handing over to his successor Mr. Jones said he had enjoyed being Chairman for the year. It had not been an easy year for Clean Air but he was pleased that not all the foreboding expressed in his inaugural speech had come to pass. The East Midlands Division had continued to propagate Clean Air and there had been some interesting meetings. Mr. Jones paid tribute to the Committee and thanked the members for their support. Mr. Jones also referred to the work of the Honorary Secretary. In handing over to Coun. Cashmore Mr Jones said he was a deservedly popular and well liked member of the Division and expressed the hope that Coun. Cashmore would enjoy his term of office.

Coun. Cashmore then assumed the Chair and having thanked Mr. Jones for his comments said that he felt the Society should now give more attention to the problems of noise and smell.

Other Officers elected were:

Deputy Chairman—Mr. K. Enderby
Hon. Secretary —Mr. E. F. Raven
Hon. Auditor —Mr. J. B. Sheard
Scrutineers —Mr. V. Wales and Mr. A. Wild

Election of one member to serve for three years on the Council of the Society—Coun. R. S. Chamberlain of Ashfield District Council was declared and elected after a ballot had been held.

The following proposal was moved from the Chair on behalf of the Divisional Council:
"that rule 5 of the Rules and Constitution be amended to require nominations for the Divisional Council to be received at the same interval before the Annual General Meeting as that required for nomination to the Council of the Society". After questions and discussion the motion was put to the vote and carried by the necessary two thirds majority. The effect is that nominations for the Divisional Council will in future close seven days before the Annual Meeting.

Mr. T. Henry Turner drew attention to the very comprehensive Year Book now issued by the Society and also referred to the Edinburgh Conference. Mr. Turner also reminded members that the last meeting in Lincoln had been on 17th April, 1952, when he himself had given a paper on "Damage to Structures caused by Atmospheric Pollution" and the former Director Mr. Arnold Marsh, O.B.E., had been present.

Mr. K. R. Enderby also referred to the Edinburgh Conference in his capacity as a member of the Conference and Publicity Committee and said that there had been criticism of the 1975 Conference because of its highly technical nature. This had been partly due to the Conference being an International one. This year efforts had been made to gear the Conference very much more to local authority members.

Mr. A. Lister Robinson asked for an indication of support for this year's Conference. While most authorities were sending delegates there were some notable omissions. Mr. Robinson also felt that more attention needed to be given to vehicle exhaust emissions.

Closing the meeting, the Chairman expressed thanks to Mr. Jones for all the arrangements for the day and these remarks were endorsed with acclamation by the meeting.

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29-30	**September** **Buildings, Environment & People**	**£50**
24-29	**October** **Air Pollution Measurement & Environmental Control**	**£110**
21-26	**November** **Solid Waste Disposal & Re-use**	**£110**

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City of London's Anniversary

21 YEARS OF CLEAN AIR

The NSCA London, South East
& Central Southern Division

OPEN MEETING

at

10.30 a.m. Monday
4th October 1976

in

The Livery Hall, Guildhall, London

speaker

Professor P. J. Lawther, MB, DSc, FRCP
President of the Society

also

an opportunity to visit the
City of London's Anniversary Exhibition
in the Royal Exchange

Estimates of Air Pollution in the United Kingdom in the year 1974

Table 1

Estimates of Pollution by Smoke and Oxides of Sulphur from the Main Uses of Primary Forms of Energy
(*one metric tonne*=0.9842 *long ton*)

Estimates prepared by Albert Parker, CBE, DSc.

Figures for quantities of forms of energy were derived from the Digest of United Kingdom Energy Statistics issued by the Department of Energy and published by HMSO in 1975. The percentages of sulphur in the amounts of the various grades of fuel used in making the estimates of pollution by sulphur oxides were provided by the coal, oil and electricity supply industries.

Form of Energy and Class of Consumer	*Million Metric Tonnes*	
	Quantity of Energy	*Quantity of Pollutant*
Smoke		
Coal		
Domestic, including miners' coal	13.6	0.42
Railways	0.1	small
Industrial and miscellaneous including colliers and power stations	81.7	0.05
	95.4	0.47
Sulphur oxides		
Coal		
Domestic, including miners' coal	13.6	0.27
Electricity power stations including generators in industry	67.1	1.93
Railways	0.1	small
Collieries	1.2	0.03
Industrial and miscellaneous	13.4	0.29
Coke ovens	18.4	0.09
Gas supply industry for gas making	0.1	small
Low temperature carbonization plants	2.6	0.02
Patent fuel plants	1.1	small
	117.6	2.63
Coke (excluding consumption in gas works and blast furnaces)		
Domestic, including other manufactured solid smokeless fuels	5.7	0.10
Industrial and miscellaneous	3.0	0.05
	8.7	0.15
Oil		
Domestic	3.4	0.02
Electricity power stations including generators in industry	17.2	1.00
Petroleum refineries, oil and refinery gases	6.9	0.32
Industrial and miscellaneous	31.6	1.26
Gas supply industry for gas making	1.3	small
Railways	1.0	0.02
Marine craft (inland and coastal)	1.2	0.02
	62.6	2.64
Sulphur oxides overall total		5.42

Note to Table 1.—The writer has found that many who use the figures such as those in Table 1 assume that they are very accurate and draw unjustifiable conclusions from comparing the figures for one year with those for another year. It should be realised that though the National Coal Board, for example, may know how much coal they have sold in a particular year, they do not know precisely how much has been used because of changes in unused stocks held by users and merchants. This is indicated by the fact that the Digest of UK Energy Statistics gives the coal consumed in the UK in the calendar year 1974 as 115.9m tons (117.7m tonnes) but 125.1m tons (127.1m tonnes) for the year 1st April 1974 to 31st March 1975, that is 9.2 tons more in the year to 31st March than in the year to 31st December; for the calendar year 1973 the Digest gives 131.3m tons but for the year to 31st March 1974 120.4m tons, that is 10.9m tons less for the year to 31st March than for the calendar year. For reasons of this kind it is not justifiable to draw precise conclusions from differences of less than 10 per cent in the amounts of smoke and sulphur oxides from one year to another.

Coal equivalents in m. tonnes of energy consumption in the UK in 1974 as calculated by the UK system of factors

		Per Cent
Coal	117.7	35.0
Oil	151.4	45.0
Natural gas	52.9	15.7
Nuclear electricity	12.1	3.6
Hydro electricity	2.1	0.7
	336.2	100.0

The conversion factors used by the EEC and those used by the UN both differ from the UK system and both give lower totals for coal equivalents than are obtained by the UK system. At the time of preparing this document the calendar year 1972 is the latest year for which the calculations are available in the UN publications. The results of the calculations of the coal equivalents of total energy consumption in the UK as calculated by each of the three systems in m. tonnes for 1972 are:

System	*UK*	*EEC*	*UN*
m. tonnes	336.6	306.6	301.8

It would be an advantage if the various authorities could reach agreement on each of the factors to be used.

Table 2

Estimates of Pollutants from Road Vehicles in the United Kingdom in the Year 1974 in Million Tonnes

Consumption of Motor Spirit	16.48m tonnes
Consumption of Derv Fuel	5.52m tonnes

Pollutant	*Petrol Engines*	*Diesel Engines*
Carbon monoxide	7.8	0.12
Hydrocarbons	0.38	0.023
Aldehydes	0.01	0.003
Oxides of nitrogen	0.24	0.07
Oxides of sulphur	0.013	0.04

The estimated quantity of carbon monoxide discharged into the air from the other industrial and domestic uses of all fuels in the year 1974 is about 8m tonnes including about 3m tonnes from domestic heating appliances. These discharges are above ground level whereas the discharges from road vehicles are at ground level.

Lead

The total amount of lead in the lead alkyl compounds added to the 16.48m tonnes of motor spirit used in the UK in 1974 was about 11,664 tonnes, or an average of 0.52g of lead per litre, the lead would be converted to complex compounds and about one-third would be retained in the lubricating oil and in the exhaust system. This means that the amount of lead in the compounds discharged in the exhaust gases from petrol driven vehicles in 1974 was about 7,780 tonnes.

43rd Clean Air Conference

Edinburgh

11-15th October 1976

OPENING SESSION - MONDAY, OCTOBER 11

20.30
Civic Welcome by the Lord Provost of Edinburgh
Formal Opening by Lord Kirkhill, Minister of State, the Scottish Office
Presidential Address by Professor P. J. Lawther

SESSION TWO - TUESDAY, OCTOBER 12

NOISE

10.00
Noise as an Air Pollutant
Dr. A. J. Crosbie, Department of Geography, University of Edinburgh

Industrial and Local Authority Approach to Neighbourhood Noise
J. H. Richardson, Senior Consulting Engineer, Acoustic Technology Ltd

SESSION THREE - TUESDAY, OCTOBER 12

SMOKE CONTROL

14.30
A Review of the Present Situation and the Way Ahead
W. J. S. Batho, Department of the Environment

Smoke Control in an Industrial Area; Experience in North East England
L. Mair, Chief Environmental Health Officer, Newcastle upon Tyne

SESSION FOUR - WEDNESDAY, OCTOBER 13

THE CONTROL OF AIR POLLUTION

10.00
The Findings and Recommendations of the Royal Commission on Environmental Pollution
Sir Brian Flowers, FRS, Chairman of the Royal Commission

SESSION FIVE - THURSDAY, OCTOBER 14

POLLUTION - URBAN & RURAL

10.00
The Health Implications of Environmental Pollution
Professor M. Howe, Strathclyde University

The Control of Pollution in Rivers, 1876 to 1976; and the Way Ahead
D. Hammerton, River Clyde Purification Board

OPEN SESSION - THURSDAY, OCTOBER 14

SOLAR ENERGY

14.30
A Panel of Specialists will discuss all aspects of Solar Energy relative to present and future possibilities. Films and demonstrations will form part of the presentation. The Panel will be prepared to answer questions on any aspect of this subject.

SESSION SEVEN - FRIDAY, OCTOBER 15

WASTE DISPOSAL

10.00
The Disposal of Toxic and Radio-active Wastes
Dr. D. H. Sharp, The Society of Chemical Industry

TECHNICAL VISITS

Wednesday Afternoon, October 13

1. Grangemouth Oil Refinery
2. Rexco (Scottish) Ltd, Comrie Colliery
3. The Caledonian Distillery, Edinburgh
4. The Fountain Brewery, Edinburgh

SOCIAL PROGRAMME

Tuesday Morning, October 12

5. Coach Tour of Edinburgh

Wednesday afternoon

6. Tour of the Scott country

Thursday morning, October 14

7. Edinburgh Castle and St. Giles Cathedral

CONFERENCE RECEPTION

Tuesday, 20.30 - 23.59, October 12
Reception and Dance at the Assembly Rooms

INDUSTRIAL NEWS

INTEGRATED HEAT AND MATERIALS RECOVERY USING INCINERATION

by

Dr. C.T. Chamberlain & Dr. R. Müller
of Universal Machinery & Services Limited

Introduction

Where materials become production waste or by-products and where they possess appreciable heating values, there are many opportunities not only for solving major disposal problems but also for material recovery using incineration. Where, in addition, there exist appreciable demands for heat, the whole process may be integrated into a recovery system which can form a profitable element of production.

It is clear that the application of these ideas can have widespread significance at a time when production waste is itself a major economic problem, when disposal of such wastes constitutes ecological and practical problems, and finally, when energy costs are at such levels that they dominate the profitability of many undertakings.

Applications

Provided that a metal to be recovered is insensitive to modest degrees of heating and the contaminant or additional metal is combustible, incineration variable is the means of heat recovery. A typical example would be where resin bonded metals are involved, such as in diaphragm valves and sealing devices, abrasive metals and metal salts contaminated with organics in chemical processes, and silver recovery from photographic materials. The basis of any application is to decide which is of prime importance in a given case—material recovery or heat recovery. That is to say, either the design is based upon a given burning condition—such as for precious metals—or upon a given heat recovery demand. The situation in which heat recovery may be made the principal factor is normally encountered when the waste would have to be dumped or otherwise disposed of.

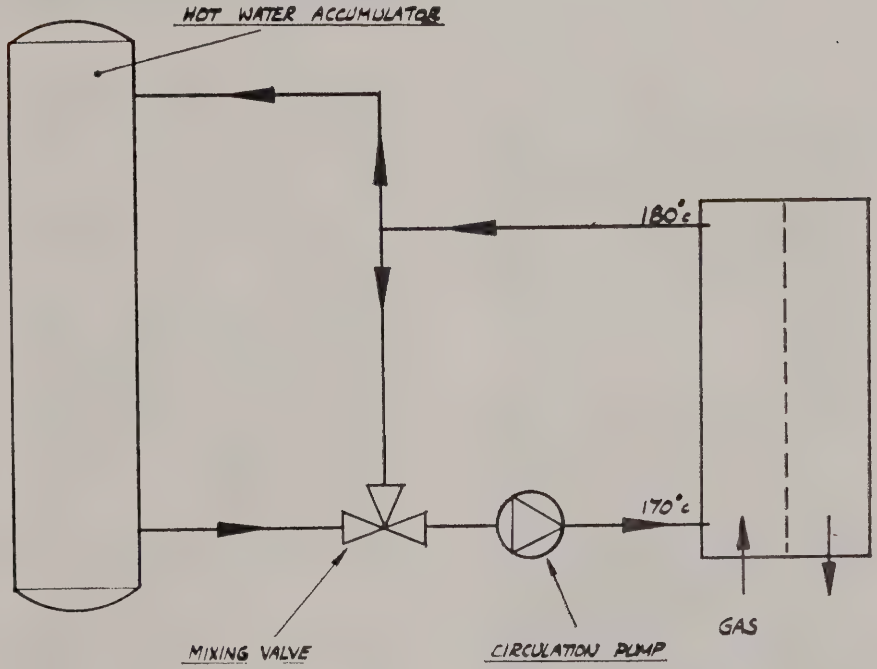


Fig. 1 Water circulating system between high pressure hot water boiler and accumulator

Design Basis

It is always necessary to evolve a design based on the particular circumstances governing the inter-relationship of disposal, and heat recovery and material recovery. It is our experience that the best systems are those in which the designer and user co-operate closely. This need stems mainly from the fact that one is often faced with integrating not only with a production process but also with an often complex energy distribution system. Maintenance is to be approached in just the same way as for any other piece of production plant—not as for an appendage to the central theme of the undertaking.

It is only possible to split the design into the following:

(a) Incinerator performance in terms of required burning rate.

(b) What additional burner equipment may be needed to provide reserve or emergency capacity to a boiler system.

(c) Boiler design criteria, having in mind the possible effects of hostile conditions on the gas side. Also, it is normal to utilise the feed and circulation system of the existing boiler plant.

(d) Gas handling and emission control.

(e) Waste and residue handling.

(f) Degree of automatic control required to integrate with the type of undertaking and type of manpower envisaged.

Economics

It is considered that of all the applications of incineration those involving simultaneous material and heat recovery offer the best return on investment cost—some exceedingly

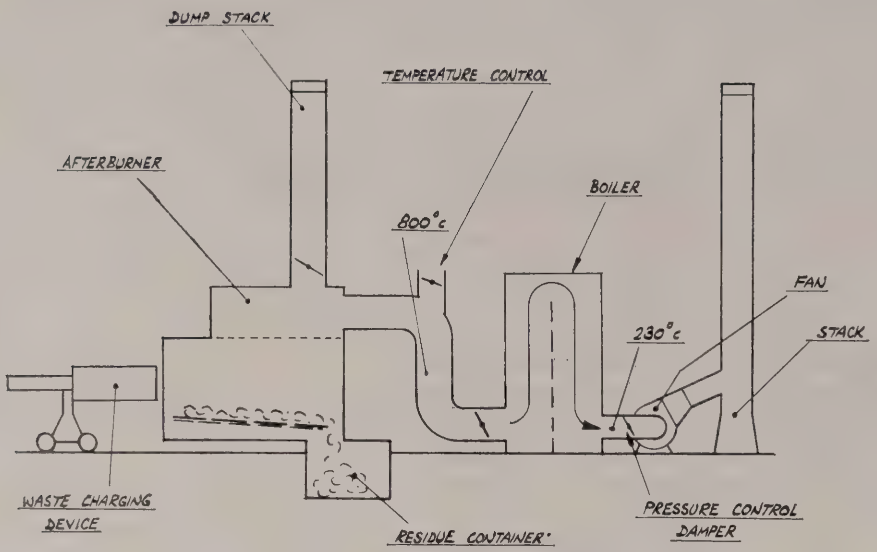


Fig. 2 Schematic layout of total plant

short payback times have been found on some of the plants within the authors' experience. It is perhaps helpful to comment that in all the cases which have been installed as working plant, no effort was spared to provide the best standards of design and some quite advanced automatic control systems were found to be desirable and economic.

Case Study

A good appreciation can be obtained from a case study of one plant for which we were responsible recently:

Waste Stream

Abrasive material as production waste.

Calorific value: 10·465 MJ/kg (4500 Btu/lb).

Combustible matter approx. 60% by weight.

Flow rate: 250 kg/h.

Carborundum recovery rate 100 kg/h.

Heat Recovery

High pressure hot water absorbing 581 kW (2 million Btu/h) in a double pass shell boiler, pressure drop on gas side: 100 mm w.g. The water flow diagram is shown in fig. 1. Gas temperature at boiler inlet controlled by air dilution to 800°C: at outlet 230°C.

Carborundum Recovery

As the particles of carborundum are released from the matrix of the paper, etc, they fall beneath the combustion grate on to a vibratory transporter which directs the material into containers which are stored in the residue receiving pit. All containers, for waste and residue, are standardised with those in use throughout the factory.

Gas Handling

An emergency 'dump' stack is provided on the combustion chamber of the incinerator so that the protection of the boiler under extreme operating conditions or fault conditions can be arranged without resorting to 'snuffing'—in addition, this provides the means to continue full smoke burning control when the boiler is out of circuit. The gas burners on the afterburning chamber can be used independently of the incinerator controls to provide a source of hot water in the event of unprecedented high demand or when the quantity of waste is not sufficient to satisfy the demand for hot water.

The general arrangement of the system is shown in block diagram form in fig. 2.

Conclusions

By exploiting the concept of burning of waste materials, as opposed to dumping or compacting prior to disposal, it is possible and economically attractive to combine heat and material recovery so as to recycle large proportions of the energy potential and production re-use.

Reader Enquiry Service No. **7637**

A GENERAL INTRODUCTION TO HUMIDIFICATION

Only recently have the public begun to appreciate that the more efficient the heating system, the more important becomes the need for humidification to restore the correct level of moisture to the air.

New buildings, in particular are not only efficiently heated or air conditioned but also double glazed and insulated as well, and the inevitable effect is a dramatic drop in indoor atmospheric relative humidity, resulting in such low and unhealthy levels as 20% rH, which is closer to the level of relative humidity prevailing in the Sahara Desert than the recommended range of 50-55% rH for a comfort temperature of 70°F. The same applies at the other extreme, and beams in a 15th century cottage will soon show signs of deterioration when the proud owner completes his restoration and sits back to enjoy his first season with central heating.

The sample figures in the chart show the high average level of relative humidity to which we are acclimatised in this country. The average is a startling 79% rH and this explains why we, as a nation, suffer particular discomfort due to the enormous and totally unnatural drop in relative humidity as a result of central heating.

The reason for this drop in relative humidity is due to the difference in water-holding capacity of air at different temperatures. When the cold outside air, which may be very damp or even completely saturated with 100% rH, is brought inside and heated to a comfortable temperature, the amount of moisture it contains only constitutes a very low level of relative humidity at the new higher temperature. For example, consider a small office of 2,500 cu ft capacity with normal ventilation of two air changes per hour, and maintained at a temperature of 70-71°F. Due to the heating, the relative humidity would be as low as 20%. To restore the required level of 50% relative humidity, humidification must be provided at the rate of 1·4 pints of water vapour per hour. This calculation makes it

Typical day in month of	Midnight	06.00 hrs.	12.00 hrs.	18.00 hrs.
January	86%	87%	81%	84%
April	83%	87%	63%	65%
July	84%	85%	62%	61%
October	90%	91%	75%	83%

Average level for the year 79% rH (for the year 1971).

Courtesy—London Meteorological Office.

obvious that to be effective a humidifier must be capable of providing exactly the right amount of water vapour and must be chosen specifically for the job in hand. Also just as the heating is normally regulated by a thermostat, a humidifier should also be automatically controlled by humidifier on and off automatically a humidistat which switches the to maintain the correct ambient relative humidity in the air.

Opening windows has no beneficial effect on indoor relative humidity but only the great disadvantage of incurring considerable heat loss. This is because the outside air is invariably at a lower temperature; and although its relative humidity may be 100%, the absolute humidity will be low and, consequently, that same amount of moisture brought indoors gives a very low relative humidity at the new higher indoor temperature.

Humidifier Applications

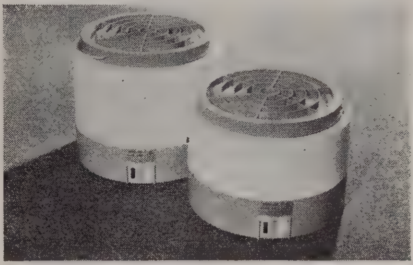
Dry air symptoms can be extremely varied and one must sub-divide the applications over the three basic types: domestic, commercial and industrial.

Domestic

During the peak central heating season many private individuals find that the air in their heated homes is oppressively dry and causes sore throats, sinus trouble, migraines and headaches: some even find that it aggravates existing respiratory complaints, and have been advised by their doctors to install a humidifier for use throughout the months of winter heating. Smokers, bronchitics and asthmatics are particularly affected.

Furniture, pianos and paintings have shown deterioration after only a few months of central heating and while it is important to understand that any damage such as splits or warping in woodwork cannot be "undone" by humidification, it is at least helpful to know that maintaining the correct atmospheric relative humidity will prevent further damage in the future. The Conservation Department of The Victoria & Albert Museum recommends that the atmospheric relative humidity should be maintained between 50-55% rH for an indoor temperature of 70°F to ensure the maximum preservation of antiques and works of art, whether the article is on show or in use in a home.

It should be remembered that woodwork of any age at all was not built for today's artificial conditions but was kilned for the wood to be at equilibrium in air of at least 60-70% rH as opposed to the level of 20-30% rH today. On the other hand, the wood used in modern furniture is often not sufficiently seasoned and may dry and split. For general domestic applications the most suitable humidifier is usually one of the Swiss Air range, made by Remploy.



These are ideal for the home on account of their complete silence. They are also completely sterile by the very nature of their operation and may be used with complete confidence and safety in any medical application, especially for respiratory problems and for inhalation where complete hygiene is vital. All the units need daily refilling and emit water vapour gently into the atmosphere where it is immediately absorbed and dispersed. They incorporate a safety cut-out device and the output is thermostatically controlled. It never actually boils and there is, therefore, no danger to children. Prices range from £38·00 for the smallest (1½ gallons capacity, ½ pint output per hour) to £58·00 for the largest (2 gallons capacity, 1-2 pints per hour output). One of the larger Swiss Airs would probably be sufficient to humidify a large flat, or small house, or bungalow, where the main rooms adjoin the hall.

Commercial

People tend on the whole to be far more critical of their working conditions than they are of those in their homes. It is rare for all the staff in even one small office to feel comfortable at the same temperature and with the same amount of ventilation. As a general rule, however, comfort conditions are normally considered to be about 21°C with 56% relative humidity. Given a more pleasant environment, staff will generally feel happier, work better and change jobs less frequently. The problem of static electricity also occurs when the relative humidity falls below 50%, but may be simply and completely eliminated if the relative humidity is maintained above this level.

Console humidifiers are ideal for humidifying large areas of up to 8,000 cu ft, such as large open plan offices. They have the advantage of being incorporated in an attractive wood grained cabinet and appear to be just another piece of furniture. An important hygiene aspect is the fact that the water tank is removable and can be pulled right out of the unit for easy cleaning and hygiene. All the controls are built-in, including a humidistat for automatic humidity sensing and on/off control. Despite its large size it is extremely quiet and very economical. These humidifiers are made by the new co-operative, The Kirkby Manufacturing and Engineering Co. Ltd., and incorporate a new British operational design. Prices range from £134·00 for the walnut model to £170·50 for the teak or white leather grain models. (Capacity about 5 gallons; output approx. 2½ pints per hour; the only installation required with these units is the fitting of a 13 amp plug).

Industrial

Certain industrial applications require specific levels of relative humidity to ensure maximum productivity. The new British Jet Nozzle humidification system which requires compressed air and water, is the most recently developed and versatile of all industrial humidifiers. Compressed air is used as a carrying element to ensure maximum moisture distribution and accuracy. Up to twenty jet nozzles can be linked to each control panel and the distribution of the nozzles designed to suit any particular premises regardless of the type of ceiling, etc. The control panel can even be outside the area being humidified but the humidistat should be located within the area itself and this provides an override control.

The nozzles are self-cleaning and multi directional with an adjustable output of between 0-10 pints per hour per nozzle, giving a maximum output of 200 pints per hour with the complete complement of twenty nozzles. One system would, therefore, efficiently humidify an area of 200,000 cu ft. There is no possibility of water contamination as the unit is fed directly from the mains water supply.

Types of Equipment—How to Choose

The choice of humidifier, whether for industrial or office, domestic or specific medical use, must be based exclusively on the following criteria:

Output—The required output of the humidifier must be calculated exactly taking into account the cubic capacity, number of air changes, prevailing ambient temperature, etc.
Hygiene—Certain humidifiers can be a serious health hazard causing lung diseases.

Control—The moisture output should be controlled to maintain the correct and balanced level of relative humidity in the air. There is a wide range of humidifiers, one of which should be suitable for virtually any application. The models have been selected on the grounds of efficiency, hygiene and safety and are all manufactured in Britain. They range from small individual room humidifiers right up to large-scale systems capable of 200 pints per hour.

Common Pitfalls—a Word of Caution

The public may well be confused by the variety of humidifiers on the market and must know what to look out for, and even more important—what to avoid. The points to which particular attention should be paid are:

Output—In some of the smaller humidifiers the output is quite negligible and totally insufficient to humidify more than the average broom cupboard. Check that the capacity and output are rated separately and that the output is given in pints per hour.

Inaccessible water reservoir—A common design problem which results in difficult, if not impossible, cleaning. Algae, bacteria and dust accumulate and the humidifier becomes stagnant and unhygienic. In some cases lung diseases such as acute alveolitis have been reported from the use of the cold reservoir type of humidifier.

Noise and draughts—In the small domestic or office range, some humidifiers make a considerable whirring sound but there are now on the market absolutely silent models which have no moving parts and which cause no draughts, air movement or temperature reduction. Asthmatics or allergy sufferers should never use fan-operated humidifiers as these can whip up and recirculate dust particles. They should only consider the steam type. Do not, however, be put off by these words of warning, but bear them in mind.

Research Project

The Humidifier Advisory Service is currently sponsoring a three-year scientific research project at Sheffield University to quantify the beneficial effects of correctly controlled humidification used in conjunction with central heating from the following physiological aspects:

—Reduction in incidents and transmission of winter colds and 'flu, by installing humidification in centrally heated buildings.
—Reduction in frequency and intensity of migraine attacks.
—Relief to bronchial, sinus and asthmatic sufferers.
—Decreased irritation to contact lens wearers.
—Alleviation of certain dry skin conditions; eczema, dermatitis, etc.
—Efficiency, comfort and performance tests and fuel saving by temperature reduction.

Another aspect that will be scrutinised, although not directly physiological, is the efficacy and hygiene of the various existing humidifiers available by means of comparative water analysis.

This is a very important aspect as any humidifier with a cold water reservoir is a potential health hazard. The reason for this is that when algal or bacterial contamination occurs, the micro-organisms can be disseminated into the air. This is most likely with the older atomiser or spinning disc type humidifiers but with the recent advances in technology, these are fast becoming obsolete. They are, in fact, only suitable for the greenhouse or conservatory.

Fan evaporation humidifiers are susceptible to the same problems. It is very important, therefore, to install a humidifier which has a direct mains water supply rather than one of the old-fashioned unit atomisation types with the water tank incorporated in the base, and to be certain that the output and control is correct.

The overall purpose of this research project is to provide statistical evidence of an optimum level of relative humidity for health, comfort and productivity reasons, and correlate it to indoor winter temperatures. It is also expected that the unnatural and ever-increasing indoor temperatures to which we have now become acclimatised can be reduced and substantial fuel savings made, as at a certain level of relative humidity one feels more comfortable at a lower ambient temperature. Also by analysing the hygenic aspects of the principles of operation of the many different models of humidifiers available, the study will clearly reveal those which are a potential health hazard.

Past, Present and Future

One can draw an analogy between central heating and humidification. We would never go backwards now to the Spartan days when we could see our breath as white mist in the ice-cold air in the bedroom—far from the coal fire downstairs. Humidification is the new 'Life Science' and it is as essential to us as users of heat as water is to those in the desert.

The Humidifier Advisory Service, the country's only specialist in this field, currently handles about 250,000 enquiries annually. They have been established for nearly ten years and have produced the only textbook on Humidification. They will advise anyone interested and recommend the most appropriate unit for any application, selecting from fully guaranteed and approved models from reputable manufacturers and will recommend local stockists.

Reader Enquiry Service No. **7638**

Pulse Jet Filter Units

Newell Dunford have recently successfully introduced the Thermix RJ series of reverse pulse cleaned felted fabric filters. The new unit designed for fully automatic continuous operation mainly consists of a series of cylindrical filter elements in a dust-tight housing. The housing is divided into two separate air plenums, the lower section contains the filter bags mounted on wire bag cages. The upper section forms the clean air manifold containing the blow tubes, clean air outlet connection and venturi tubes. Dust laden air is admitted to the lower housing and clean air is withdrawn from inside the filter cylinders to the upper plenum. As dust laden particles accumulate on the filter elements, periodic cleaning is accomplished by the automatic introduction of a momentary pulse of high pressure air opposite to the incoming flow. This pulse is used on only a fraction of the total number of bags at any one time, which means that only a very small amount of the total filter area is cleaned simultaneously. This ensures a continuous flow through the collector and steady exhaust conditions at the exhaust point.

Easy access is by hinged top inspection doors which allow quick bag inspection and top bag removal without entering the bag house. The collector is normally supplied as an all-welded modular stack-up construction to minimise bolted joints and eliminate the possibility of air and water leaks. On high temperature applications the housing is insulated with a layer of fibreglass. Units are supplied with a continuous trough type hopper complete with screw conveyor mounted in the base or individual pyramid type hoppers for intermittent periodic emptying with the storage capacity arranged to suit clients' requirements.

Reader Enquiry Service No. **7639**

Silent Karrier

A new battery operated delivery van capable of speeds of up to 40 mph (64 km/h) and carrying a pay load of 35 cwt (1780 kg) has been produced and developed by three of Britain's leading organisations. Five of Britain's leading urban transport operators announced their firm intention of testing electric vehicles by taking options on 15 of the new vehicles.

Called Silent Karrier, the new vehicle was designed and built by Chloride Group Limited, the commercial vehicle division of Chrysler United Kingdom and the National Freight Corporation. It is already in operation with National Carriers Limited, Europe's largest freight company, a subsidiary of NFC.

In addition to NCL the major users who have decided to evaluate Silent Karrier within their existing fleet are Unigate, Advance Laundries, W. H. Smith and Ranks Hovis McDougall. The operators believe that Silent Karrier with its lower running and maintenance costs and the proven reliability of the electric vehicle in stop start applications could be of great benefit to the economics of their fleet operation.

Silent Karrier has been specifically developed to operate in congested city centre conditions. Using the latest electronic controls, similar to those incorporated in Britain's first battery bus Silent Rider which has been in fare paying service in Manchester for the last 18 months, the van can operate smoothly and at high speed. It is particularly suitable for delivery of parcels, small freight and consumer goods and has already had a good reception from the National Carriers depot in Birmingham, who have operated the prototype in service since February.

The existing prototype vehicle will continue in service with NCL over the next 18 months, by which time the preproduction batch of vehicles will be delivered to the operators in accordance with the options. These will then be evaluated in service over an extended period.

Silent Karrier is a development of the highly successful Dodge-Commer-Karrier range of Chrysler delivery vehicles and these have been among the most successful delivery vans ever made in Britain. The Walk-Thru design makes it ideal for battery power.

Rather more than 75% of all urban delivery transport either travels over a fixed delivery route, or one which has a maximum delivery range. In either case the maximum range is well within the 40 miles (64 km) capacity of Silent Karrier. It has a maximum speed of 40 miles/h (64 km/h) which exceeds the top speed requirements of urban delivery transport.

The initial purchase price of the van is about 50% higher than a conventional ICE vehicle but operating over a period of 10 years, lower running and maintenance costs will give Silent Karrier an economic competitiveness with conventional vehicles.

National Carriers Limited has used Silent Karrier on a 35-40 mile (56-64 km) stop-start delivery operation in Birmingham since February. Even in this short period of time the reliability of the vehicle is becoming established. It has the speed, acceleration and range to do the job that well over 75% of all town based 35 cwt (1780 kg) vans are doing today.

Silent Karrier is the result of a unique partnership between Chloride, Chrysler and National Freight Corporation. Chloride is pioneering an international programme of developing electric urban vehicles of all kinds. As well as designing the drive train for the new vehicle, Chloride has developed a new high energy density lead acid battery which will greatly increase the operating range of Silent Karrier without any significant reduction in battery life. New batteries are also being developed by Chloride such as sodium sulphur which will give Silent Karrier a range of well over 100 miles (160 km) per day.

Reader Enquiry Service No. **7640**

West Sussex Household Rubbish to be Used as Fuel for Cement Making

Refuse from West Sussex households is being disposed of as part of the fuel in the making of cement at the Blue Circle Group's cement works at Beeding, Sussex, from the beginning of May.

Extended trials are to be run at the works to establish just how much rubbish can be used as a part substitute for coal in the cement kiln. At the start 350 tonnes a week will be used, which is more than half the throughput of West Sussex County Council's pulverising plant at Sompting, five miles west of the cement works.

Announcing the first full-scale extended test in the country of using household refuse as a fuel, Mr Martyn Long, chairman of the County Council's General Purposes Committee, said it had come about as a result of negotiations between the County Council's Waste Disposal Officer, Mr Austin Laybourne, and the Blue Circle Group who had made suitable alterations to their plant.

"I think this is one of the most exciting projects which has been dealt with by my committee. The problem of getting rid of our rubbish is very real in this county, and the opportunity to use some of it as a fuel caught our imagination right from the start. There is a tremendous appeal in using waste as a fuel—putting it to work instead of treating it as a 100% liability. I believe we are seeing the beginning of something which will grow with the years."

The county surveyor, Mr William Harrison, whose department has the responsibility for disposing of household refuse, said: "This scheme has one very great attraction for us—it gets rid of rubbish which would otherwise have to be tipped in holes in the ground, and this county is woefully short of suitable tipping places. As far as cost is concerned, disposing of it at the cement works is likely to be cheaper in the long run than tipping it."

West Sussex has 280,000 tonnes of domestic refuse to dispose of each year. Blue Circle may eventually take around 60,000 tonnes of it, and they are most enthusiastic about the new process which is designed exclusively for use in conjunction with cement manufacture.

Blue Circle works director, Dr Gordon Marshall, enthusiastically supports this joint venture and says

"An additional advantage of burning refuse in a cement kiln is that the gases produced on combustion are neutralised by the alkaline materials, chalk and clay, used in cement making. Adjustment of the proportions of these raw materials ensures that there is no adverse effect on cement quality. The kilns are fitted with electrostatic precipitators to clean exhaust gases before they are discharged to atmosphere." He went on to add that his assistant director, Mr Jack Templer, who is in charge of the commercial development division and who has been in touch with West Sussex County Council throughout, is actively engaged in the installation at Beeding as well as similar proposals in this country, Europe and the United States.

Cement kilns at Beeding are two 350ft long rotating steel tubes, 10ft in diameter. The raw materials for cement making are fed in at one end and at the other a source of heat is provided by pulverised coal. As the cement slurry travels down the kiln it is first dried and then converted by a chemical reaction to cement clinker at a temperature of up to 1,450°C. To achieve this temperature large amounts of fuel are required. Thus Beeding, producing over 300,000 tonnes of cement a year, consumes about 75,000 tonnes of coal. From the beginning of May, however, the fuel ceased to be 100% coal and became a mixture of coal and pulverised household refuse. It takes four or five tonnes of pulverised refuse to produce the same amount of heat as one tonne of coal.

Such is the interest in the process that Blue Circle are organising a symposium at Beeding to enable local authority representatives from all over the country, and representatives from the Department of the Environment, to discuss it and see it in operation.

Reader Enquiry Service No. **7641**

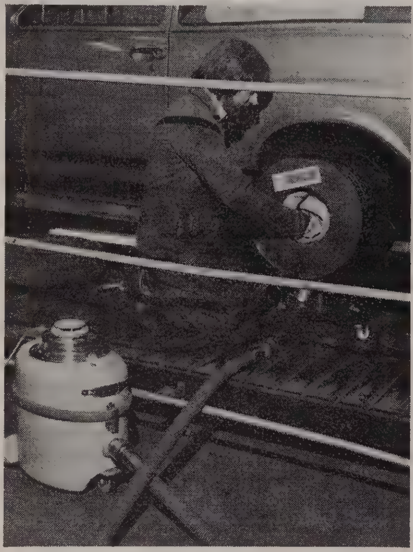
Ipswich Garage Avoids Health Risk With Nilfisk

The potential health hazard from asbestos dust, as a result of brake drum cleaning in the motor trade was recently solved extremely easily at G. C. Akester Ltd, the long-established British Leyland dealers.

A recent and extremely effective addition to the workshop at the garage is a BT200 brake drum unit which is connected to a Nilfisk suction cleaner.

Mr R. J. Dunnett, managing director of Akesters, is very conscious of staff welfare and working conditions. He explained that the repair workshop at the garage is modern and comfortable to work in, being well heated and ventilated.

He added that these excellent working conditions had, however, accentuated the problem of asbestos dust, since the draughts of cold air normally associated with motor repair workshops had been virtually eliminated. This meant that asbestos dust from brake drum linings was able to freely circulate in the air.



For this reason, Mr Dunnett and his staff decided that it was vital to install some kind of dust-extraction system. He went to the Motor Show with the aim of finding some machine to combat the problem.

He placed an order for a BT200 brake drum unit and Nilfisk GA71 suction cleaner. When this was put into operation at the garage, Mr Dunnett and his staff were delighted with the results. The system has drastically reduced the danger from asbestos dust, as this is not allowed to escape into the air but is sucked directly into the suction unit. In addition, the system has greatly improved the working conditions for this previously very unpleasant job.

A further benefit of the system is that the Nilfisk suction cleaner can easily be uncoupled from the system and used for general cleaning throughout the offices and workshop areas of the garage.

Reader Enquiry Service No. **7642**

Gas From Coal Development

An achievement of international significance in the search to find economical methods of producing substitute natural gas from coal was announced in March by British Gas, in conjunction with American sponsors of an important new project being carried out at British Gas Westfield Development Centre, Fife, Scotland.

The British Gas Slagging Gasifier reached a new milestone in its development with recent completion of two extended tests each of 7 days' duration at the Westfield Development Centre, Fife, Scotland.

This new gasification process is being sponsored by a group of 15 U.S. oil and gas companies. Conoco Coal Development Company serves as the co-ordinator for the U.S. sponsors. The programme has been under way for a year.

During the test, a synthesis gas ideally suited for further conversion to substitute natural gas was produced at a rate of up to 25 million standard cubic feet/day. Each test was of planned duration and part of the programme of development.

These new developments mean that British Gas is closer to the fruition of a research and development programme initiated in the 1950's by the British Gas industry at the Midlands Research Station at Solihull. The development was taken as far as the pilot plant stage in the mid-1960's, but work was suspended following the discovery of North Sea gas.

A critical shortage of natural gas in the United States, which has an abundance of easily-mined, comparatively low-cost coal close to the surface, has revived interest in coal gasification technology to help to meet this shortage.

The development work is located at the Westfield Coal Gasification plant, until 1974 used to produce manufactured gas for the surrounding area of Scotland before the changeover to North Sea gas. In the conventional process used at Westfield coal is gasified at high pressure with steam and oxygen, the mineral waste of the coal being removed as a solid ash. The new British Gas process operates at much higher temperatures, so that the ash melts and is withdrawn as a molten slag—hence the plant is called a Slagger Gasifier. The high temperatures are produced by supplying only a fraction of the steam used for the conventional gasifier and results in the plant having a higher thermal efficency and up to four times the gas output. Its more economical use of steam also reduces effluent and environmental problems. The gas produced can be processed to provide a substitute natural gas. Alternatively, the relativity low calorific value gas can be used for industrial or petrochemical applications.

Work will now continue at Westfield on the Slagging Gasifier to further improve the process. A consortium of 15 North American firms and utilities is contributing approximately $10 million to meet the costs of the development work. It is the third major project carried out by British Gas at the Westfield Development Centre for American sponsors.

Reader Enquiry Service No. **7643**

CLEAN AIR

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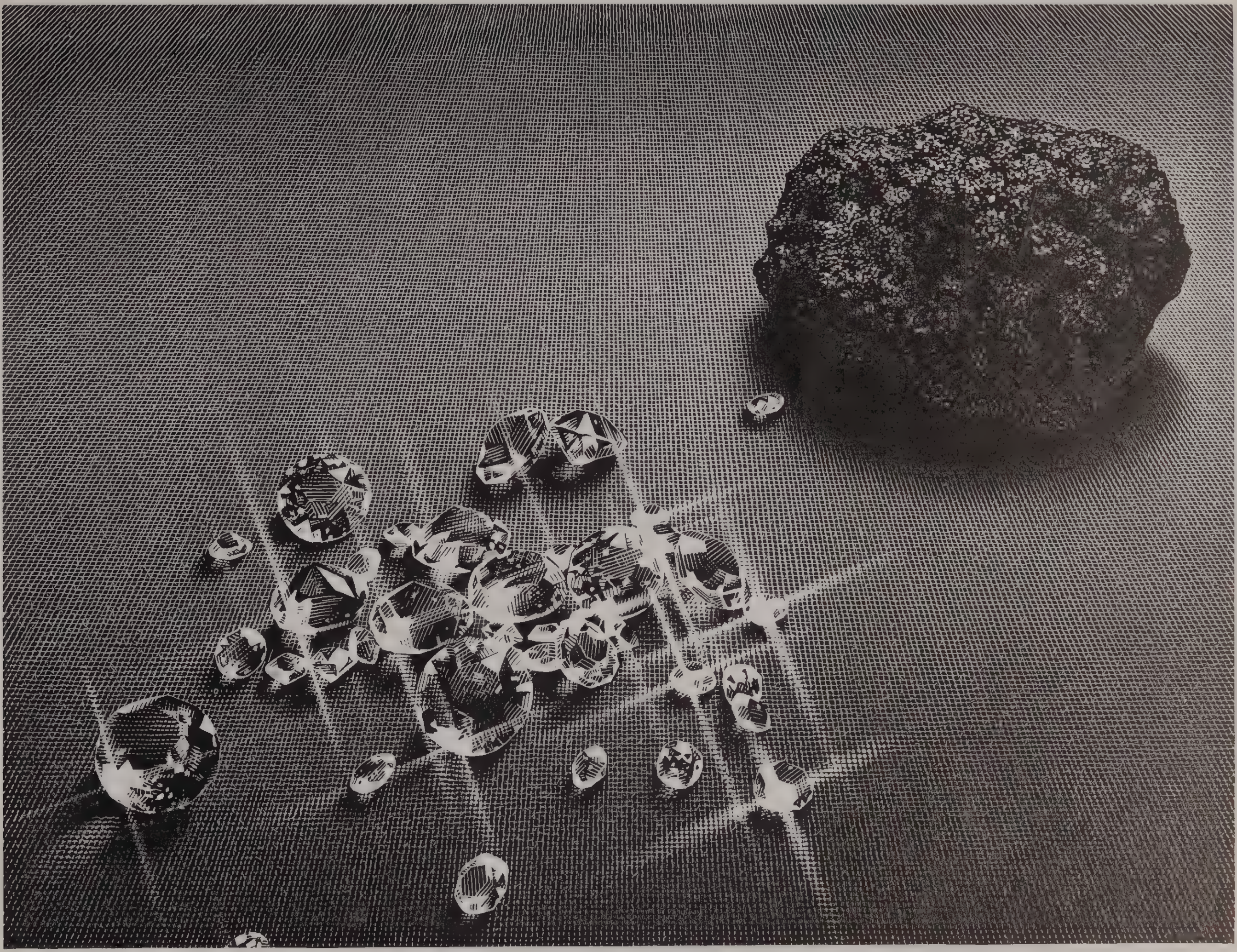

**Coalite, like diamonds, is a form of carbon.
Coalite, like diamonds, is precious.**

Carbon is a pretty surprising element. It turns up in some wild guises. Like diamonds. Men have killed for them. Women have succumbed for them. Fortunes have been founded on them.

Diamonds are precious.

Another of carbon's guises is known commercially as Coalite. That, too, is precious. That, too, has had a spectacular effect on people's lives. Coalite has helped to make towns and cities nicer places in which to live. Cleaner places. Happier places.

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CLEAN AIR

AUTUMN 1976
VOL. 6 NO. 23

The Annual General Meeting

The Future of Pollution Control
the Rt. Hon. Denis Howell, M.P.

Smokeless Zones—The History of their Development
C. V. Malcolm

District Heating and the Forces of Change
B. Manifold

Industrial News

News from the Divisions

Pollution Abstracts

International News

Change & Challenge in Dustrol Control Engineering
Peter Swift

Book Reviews

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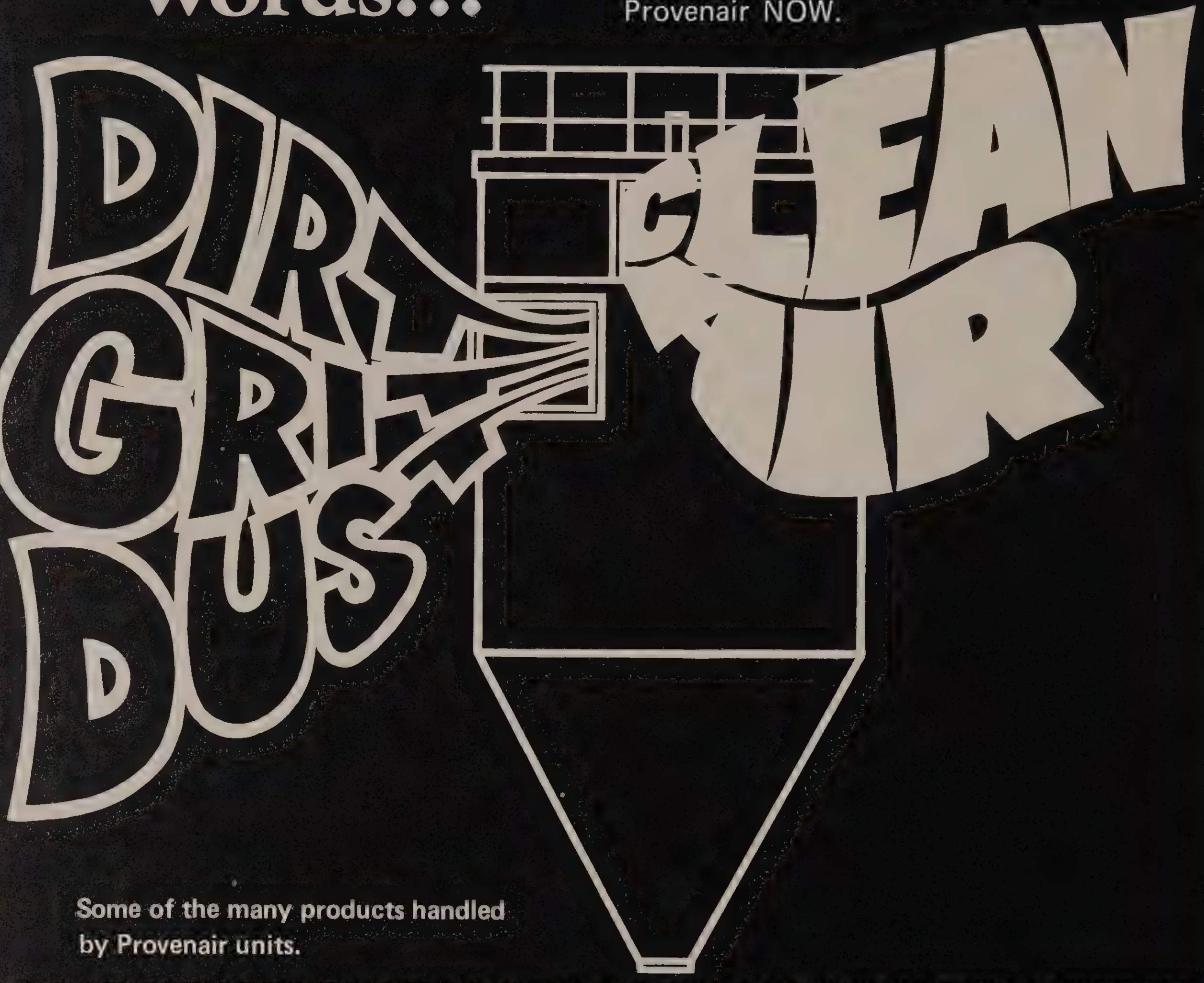

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CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

Vol. 6 No. 23 **Autumn 1976**

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Diary of Events

29th October (Friday)
p.m. Meeting of the Northern Division.
Carlisle.

3rd November (Wednesday)
a.m. Parliamentary & Local Government Committee Meeting.
p.m. Technical Committee Meeting.
London.

10th November (Wednesday)
a.m. Conference & Publicity Committee Meeting.
p.m. General Purposes & Finance Committee Meeting.
London.

25th November (Thursday)
p.m. Meeting of the Council of the Society.
London.

16th February 1977 (Wednesday)
a.m. Technical Committee Meeting.
p.m. Parliamentary & Local Government Committee Meeting.
London.

24th February (Thursday)
a.m. Conference & Publicity Committee Meeting.
p.m. General Purposes & Finance Committee Meeting.
London.

9-10th March (Wednesday & Thursday)
6th Clean Air Spring Seminar on 'Noise'.
Manchester.

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Industry and the Environment

In the early days of the Society its members were all individuals; but as the Society grew and its aims of influencing 'the vestries' to implement some form of smoke control—many will remember that the Society at one time employed its own smoke inspectors—increased, then efforts were made to recruit 'the vestries' i.e. the local authorities as members of the Society. Today, of course, we have a membership which is made up of individuals, local authorities and industries. But after the local authorities were admitted to membership, many years were to pass before the Society would admit industrial members. At that time industry was regarded as the enemy; it was industry which made most of the smoke; it was industry which caused most of the pollution in the air — the enemy with whom the Society would have no dealings.

Fortunately for the cause of clean air and fortunately for the Society itself, over the years attitudes changed and commonsense prevailed. Industrial members were recruited, mostly from the fuel industries, and from them the Society has received very valuable support not only in the technical field but also in the financial field. So far as smoke is concerned, it should be remembered that industry began to put its house in order long before the Clean Air Acts and long before it was realised that domestic smoke was responsible for so much of the smoke in our atmosphere indeed, as it still is today. True, industry emits pollutants other than smoke; but over the years, as a result of the enforcement of the Alkali Acts, and the application of the philosophy of the best practicable means, to a large extent this has been brought under effective control. Although much of this has been done by industry itself, the Society has also played a very large part in that it has provided a forum where those who are causing pollution and those who were responsible for the enforcement of anti-pollution measures could meet with those who sought improvements and so fully debate such matters.

But as the technology of the control of air pollution advanced, so there was an increasing demand not only for equipment to control pollution but also for instruments to monitor and measure pollutants in the atmosphere. As a result of this, a complete new industry arose and some members of this industry were in turn recruited to the ranks of the Society. They, too, have played their part in the Society's discussions at its conferences and seminars. But whereas the fuel industries were so organised that they constituted national bodies and so were entitled to direct representation on the Council of the Society, the manufacturers of equipment for the control of pollution and the protection of the environment were not so represented, and their voice was not heard so effectively.

This was realised by the Society, and at the beginning of this decade efforts were made by the Society under the auspices of its then President, Mr. Stanley E. Cohen, CBE., to establish an association of manufacturers of control and monitoring equipment. Towards the end of 1972 the Environmental Protection Equipment Manufacturers Association was inaugurated in London and during the last four years it has steadily grown, not only in membership, but also in stature. Appropriate government departments have come to recognise the existence of EPEMA and as occasion demands the Association is in contact with the Department of the Environment, with the Department of Industry and the Department of Trade and through them the EEC. EPEMA is now regularly approached and consulted on matters about which it is in a position to make a contribution. EPEMA is closely connected to the Society, which provides some of its administrative backing. The Association is now represented on the Council of the Society and on the Conference and Publicity Committee and the Technical Committee.

Membership of EPEMA is open to manufacturers of equipment designed to reduce, measure and monitor pollution emitted to the environment, the installers of such equipment and those who use such equipment to provide services for the measurement, control and abatement of all forms of pollution. The Association is non-profit making and financially is supported entirely by subscriptions from its members. Its main aims are to negotiate with appropriate government Departments regarding equipment available for the reduction and the monitoring and measuring of all forms of pollution; to establish attainable and maintainable standards for such equipment and to ensure that members of the Association comply with such standards. A further and most important aim is to seek to improve the standard of equipment supplied and installed by members.

In the past EPEMA has shared stands at suitable exhibitions with the Society but at the forthcoming ENPOCON Exhibition which will be held in Birmingham from 15th to 20th November 1976, EPEMA will have its own stand manned by its members to present to the public its aims and objects. It is hoped that members of the Society visiting the exhibition will call at the EPEMA stand.

The Annual General Meeting

Mr Howell greeted by Professor Lawther

The Society's Annual General Meeting took place on Wednesday, 7th July, at the CEGB Theatre, Sudbury House, Newgate Street, London EC1. About 50 members and representatives were present.

Mr R. A. W. Hollingdale, Honorary Treasurer, presented the financial statement for the year ending 31st March 1976. He regretted to have to report a loss on the year. Going through the income and expenditure account in some detail, he stated that although the subscription income had been increased, that from Conferences and Seminars was down and there had been large increases in expenditure. This was due to inflation and, undoubtedly, the poor attendances at Conference and the Birmingham Seminar had been influenced by the current financial climate.

In presenting the balance sheet, Mr Hollingdale was happy to be able to report that the value of the Society's investments, as a result of market trends, had increased.

Mr Cohen commented that there had been a turnround of £13,000 from the previous year. There had been a loss of £7,000 this year whereas last year there had been a profit of £6,000. He asked where the Society was going. Salaries had gone up £6,000 and the cost of the pension scheme had doubled. Mr Hollingdale, replying, explained that salaries of staff were in line with those of local authorities and there had been a very big increase early in the year. He reiterated that the support for the Conference and Seminar had not been as good as expected; in fact, it had been poor. As a matter of deliberate policy, subscriptions had not been increased for over two years in spite of the high rate of inflation. With hindsight now, it was possible to say that perhaps subscriptions should have been increased, but, of course, this might have meant the loss of some members. The question of increase in subscriptions was now being examined. In the meantime an appeal had been made to the Society's larger subscribers, notably the fuel industries, and the response from them had been very generous. At the same time, steps were being taken to save expenditure and how this might be done was being examined in detail by the various Committees and the Council. The possibility of making reductions in staff had also been kept in mind and already one member of staff had been replaced by a person working part-time. Mr Hollingdale stressed that one of the best means of helping the Society financially was by ensuring that there was good support for Conferences and Seminars and he enjoined all those present to do everything they could to see that there was good support for the Conference in Edinburgh in October and for the Seminar in Manchester in March 1977.

Mr J. Clancey, OBE, Chairman of the Council, introduced his Annual Report and described the year as one of sustained effort. The impetus of the Society had been maintained and the Brighton Conference, in spite of the fact that it had not done so well financially as those Conferences immediately preceding it, had made a profit. Beyond this, it was a very good Conference with some very good papers. The same could be said of the Birmingham Seminar. It had been attended by over 100 people and although this did not compare with the numbers attending at Newcastle, technically it had been a very good Seminar indeed.

Professor P. J. Lawther was re-elected as President of the Society for a further term of one year. Mr R. A. W. Hollingdale was re-elected as Honorary Treasurer for the ensuing year. Messrs George Little, Sebire & Co were reappointed as auditors to the Society.

The Business Meeting was followed by the Public Meeting which was addressed by the Rt Hon Denis Howell, MP, Minister of State for the Department of the Environment. His address, entitled 'The Future of Pollution Control', is published below.

'The Future of Pollution Control'

Address to the NSCA Public Meeting

by

the Rt. Hon. Denis Howell, M.P.,
Minister of State for the
Department of the Environment

I have had a long-time interest in air pollution affairs, going back 30 years to when I was on the Health Committee in Birmingham and we were busy trying to establish smokeless zones. Ten years later, when I got to Parliament, Sir Gerald Nabarro was trying to get his legislation through Parliament. He withdrew that legislation in 1955 or thereabouts on the promise of the then Government introducing their own legislation. So the first bill of the committee on which I served in the House of Commons was also the bill of the establishment of smokeless zones. I put that experience to good effect, and enjoyed immensely grappling with such sordid problems as the proper place of the Alkali Inspectorate in relation to local authorities. I remember Sir Gerald Nabarro, who never did anything by half measures, shocked the committee on the first day we met by putting down 350 amendments. When we reached about day 22 of the committee procedure to discuss these difficult amendments on the Alkali Inspectorate, Sir Gerald was taken ill. I think the reason for his illness is that I, as an immature, abrasive, cheeky, young Member of Parliament, thought that if he put 350 amendments down they ought to be debated, so I signed my name to every one of them. The result was that he could not withdraw them without my agreement. This was a very interesting exercise, as it turned out, because when we came to the question of the role of the Alkali Inspectorate and local authorities, I found myself in charge of this operation because of Sir Gerald's illness.

We do owe Sir Gerald a debt of gratitude for being one of the buccaneering types of pioneers one needs in Parliament and without whom new legislation would never get onto the statute book.

Now that I have some Ministerial responsibilities for these affairs, I would like to express my appreciation and thanks for the co-operation of the Society in our recent legislation. I do not pretend that it is everything you wanted but I do believe that in the Working Party we now have, which I have the privilege and pleasure of Chairing, that we have a remarkable degree of harmony between the Government on the one hand and everybody in the 'Trade', if I can use that description to apply to you all, on the other. It is because there has been this remarkable degree of harmony that I think such substantial progress has been made.

I have a delightful office on the 19th floor of the Department of the Environment, and I look out over a magnificent spectrum of Buckingham Palace, the House of Commons and Westminster Abbey, and in between are cleaned-up buildings. Whenever colleagues and Ministers from overseas visit me the first thing I say is "Look out of the window at my splendid view. That's how we've cleaned up London." I find that has a bigger impact upon them than almost anything else I can say to them, because it really is dramatic. The physical evidence is before our eyes and that is something of which we can all be proud. I applied the same tactics recently with my European Colleagues in the EEC, when there was some disagreement over our Best Practicable Means approach. I said "Look out of the window and show me another European Capital that can boast these splendidly cleaned up buildings, no smoke, and visibility stretching for miles". I really think that is the best tribute one can pay to your Society and to the co-operation between Government and yourselves.

I will now move on to the future of Air Pollution Control, which is much more to the point than a long dissertation about the past. The 1956 Act, with which I became very involved is, of course, still being carried out in the sense that not all parts of the country have followed London's example over smoke-control. Particularly in the North West and the North East, it is still very relevant. There is still work to be done on this continuing problem, but I doubt very much whether this is legislative work. I think it is operational work. It is a matter of applying the legislation we have made available, and a question of local authorities making use of the machinery available to them. Government grants have not been reduced or rationed, and this a point I would like to comment on, since whenever I suggest a new idea within Government, I am always told of the difficulties of the economic situation, that we cannot make additional resources available, that local Government is being asked by Central Government not to exceed certain limits, and that Central Government is undertaking not to require local authorities to do anything which might involve additional expenditure. Under the present system devised by the treasurers of local authorities and connived at by the Treasury in Whitehall, we give local authorities a block-grant to spend as they may. Personally, I always resist any attempt to tell local authorities what they should or should not do with the money from Parliament. If local authorities, therefore, wish to spend more money on smoke control or the control of noise, or anything else, that is their decision. I constantly urge my colleagues not to keep sending out circulars stating what the effects of likely cut-backs will be. But a serious point which I want to emphasise is that if you are under pressure because of the present economic situation not to do things, then whilst it is true that no additional financial resources can be made available to you at this time, what you actually do with the resources at your disposal is your business, and nobody else's. That is the basis on which local government organisations and local government finances is hallowed by law in this country at the present time. Every local authority's problem differs from that of all its neighbours. This is another good reason for them to determine their own priorities. Those authorities who have already cleared up the atmosphere will not be very interested in being told that no resources are available for this purpose. They will have a different problem and they may wish to deal with it in their way.

I would like to move on now to the Control of Pollution Act 1974. I hope, since I am one of the people responsible for it, that you will not mind if I say that this is probably one of the most important pieces of environmental legislation seen in this country, or indeed any other country, in recent years. I know from talking to my European Ministerial colleagues that it is way-ahead of the legislation now available to most other European countries. One of the most important effects of that legislation is, of course, that the word ‘pollution’ itself now covers a much wider range of subjects than was the case a few years ago. The Control of Pollution Act does recognise this wider concern and for the first time envisages an effective control over a whole range of problems. The significance of this new-look at pollution control has not, I believe, been lost on many people in other countries who have a high respect for the success we have achieved. The noise provisions of the Act, for example, are now fully operational. Here we have taken the establishment of smoke abatement zones as our guide in attempting to deal with noise pollution by establishing ‘noise abatement zones’. We are attempting for the first time to measure the amount of noise within a given area collectively and then to see how that collective level of noise is made up by individual units, such as factories, within this area. It will then be an offence for anybody within that noise abatement zone to add to the noise level in any way, thereby using our well-tried Best Practicable Means system in trying to reduce the noise levels over the years. This is a revolutionary concept to everybody to whom I explain it, and they say they have grave doubts about it. But when I point out that these are exactly the principles by which we have so splendidly cleaned up London, Birmingham and other cities, and why we are now getting so much sunshine, they then begin to understand that there is a great deal to be said for our practical approach to these problems. I think that the sections of the Control of Pollution Act dealing with waste disposal and atmospheric pollution might well come into force in late summer because regulations giving the effect of the remaining provisions might then be made. I would not want to give the impression that we intend to stand still in any moves of self-congratulation. I am sure that if there was any temptation to do so the distinguished members of your organisation would not allow it. But other pressures are making themselves felt. Although embarrassing for Ministers and Governments, the build-up of a very informed environmental lobby in this country is a most encouraging sign. I welcome the fact that Government and Ministers are being forced to answer for their sins of omission and other sins, by such an environmental lobby, and I think much evidence arises from that about the pattern of public anxiety and concern. The old pollutants have, by and large, gone, particularly smoke, but other pollutants are with us and the public are becoming increasingly aware of this. During the past six months there were two debates in Parliament concerning ozone and aerosols, about which little information is available and where a great deal of research needs to be done. Again we have, on the one hand, the British practical approach, compared with the American idealistic approach where as soon as a possible danger is identified, attempts are made to ban it even though the amount of information available hardly justifies legislative action. But I welcome these debates, and the concern which exists over these matters. I am sure that as a result of public pressure and anxiety we shall be commissioning more and more research and obtaining information on which to base sound proposals to Parliament. All the current areas of concern are very live on the agenda in the Department of the Environment and on the Parliamentary order paper. Of course, any Politician is bound to take account of these public concerns. It does seem to me, therefore, that your Society, in these changing times, has an absolutely vital educational and lobbying role to play. It is important to me as the Minister on the receiving end to have a Society such as yours organising, educating and informing the public and Members of Parliament about the principles involved, the possibilities open to us and the dangers of precipitantly running into action before we have informed ourselves adequately.

I have been asked to say a few words about Departmental Circulars and I understand that some misunderstanding may have arisen concerning some of the Circulars we issued recently. I therefore wish to emphasise that the object of the Circulars was to point out to local authorities that whilst a wide range of desirable work needs to be undertaken, a limited amount of money is available. Local authorities have to determine their own priorities. The danger on occasions such as this when we run into economic difficulties is that some ill-informed councillors might think that smoke control is on the margin of concern for local authorities and that it can be put back or stopped. I therefore think the educational work the Society has to do is of enormous importance in the whole of this field. The programmes of recent years on smoke control have varied a little, but they constantly remain between £3½m and £4½m. It would be a tragedy if that money was channelled off by local authorities and used in other ways, as I think it would then be very difficult to get it back again. I do hope, therefore, that if local authorities cannot extend their programmes at the moment, they will at least try to keep their programmes reasonably within those figures.

I would like to talk for a few minutes about the EEC, with which organisation I seem to spend an increasing amount of my time. I welcome the fact that we are now members of the European Community and have to justify our British Best Practicable Means approach. This is something which should not worry us, if we can prove that our methods have been succeeding. We had no difficulty in the case of clean air or in dealing with waterways in proving that our system is successful. Because it was tailor-made to be practical and pragmatic in its approach, we managed to carry industry, local authorities and the public with us. This is not, therefore, something which should be thrown away. We do not want to dissipate this collective amount of public goodwill which the British approach has built up over the years.

Concerning the immediate future of the EEC proposals, we have the Gas Oil Directive which is at present in operation dealing with the sulphur content of gas oil. It will, I think, have relatively little effect in this country at first, because the average sulphur content of gas oil used here is below that required by the community up to 1980. After 1980, slightly more rigorous standards will apply because of the effect of that Directive, and no doubt your Society and others will be thinking about that. Discussions are currently going on within the EEC about two other Directives. First, the Health Protection and Standards Directive, which seeks to set levels for the amount of smoke and sulphur dioxide in the atmosphere—not very different from the guidelines envisaged in the 5th Report of the Royal Commission. The levels proposed there are based on the World Health Organisation Report which, in turn, is very largely based on the work of Professor Lawther. There is, therefore, no need for me to say much more about it since I expect, the Professor, as always, has got it just about right. The UK is of course supporting the principle of this Directive, although we think careful study of the details is needed in the drafting. The second of the new Directives under discussion is that which proposes to set limits to the sulphur content of fuel oil and this would have a serious effect in the United Kingdom. It does not seem to us, as at present drafted, to be very relevant to our requirements, since we have a different pattern of fuel users in this country from most of the EEC—for example, we use much more coal. Here again, the UK emphasis is much more on ‘ ends ’ rather than ‘ means ’. Both these Directives are at a very early stage and under intensive study, but they do indicate how our pollution control arrangements will have to take account of the wider considerations brought about by Europe.

Perhaps a word is not out of place on the question of ‘ Best Practicable Means ’ versus ‘ standards ’, the great issue with which I have been involved. We regard our procedures as being far more flexible and realistic. The advances in pollution technology can be more easily taken into account under our system than by laying down absolute standards. It is also possible with our system to take account of economic factors and, most important, our system has worked, as we have repeatedly been able to demonstrate.

Finally, where do we go from here? I think that the work we have done, the work that the Society has done, together with the Fifth Report of the Royal Commission, does indicate the way ahead for pollution control. One of the Royal Commission’s major recommendations was that of the establishment of a unified Pollution Inspectorate. This is still, I believe, a matter for debate within Government. I took the opportunity at the last meeting to consult the council about it, and a surprisingly large degree of agreement was obtained on that occasion and the advice to the Government was obviously stronger on that account. I believe a great number of people think there is a lot of sense in this recommendation of a unified Inspectorate. There is plenty of room for discussion as to where such an Inspectorate should be housed. The advice I have been given is that it ought possibly to come back to the Department of the Environment. But there are other agencies at work giving contrary advice to other Government Ministers. If we are going to have a unified Inspectorate, it will be important for your Society and for others to speak out firmly on where you think it should be housed, and how it relates to local authorities, the Health and Safety Executive and other similar agencies in the field.

I would conclude by saying we have indeed made substantial progress in this country in recent years about which we can all take a measure of pride. We are not resting upon our laurels. The Control of Pollution Act is evidence to the world that, based on our past successes, the lessons we have learnt are going to be applied in a wide range of other environmental situations. We recognise we have a long way to go, but the Control of Pollution Act itself, which was supported in Parliament on all sides by all political parties, seems to me to be the best guarantee to the world, especially to our European colleagues, that we continue to take the improvement of the environment as a matter of major concern. Not only will we pay lip service to this ideal, but in hard practicable terms, we organise our national Inspectorate, our central government and our local government to deal effectively with these pollution problems, not just in the atmosphere but in noise and in water—in fact right across the environmental spectrum. When I visit schools nowadays, which I do quite often, one of the things which impresses me is the amount of environmental concern to be found among young people. Almost every school has a environmental society. I am always being approached by young people urging me to do something about otters or snails and demanding to know what the government is going to do. Young people come up to me very indignantly and say “This is our world and what are you doing to improve it?”. This is, I think, an absolutely magnificent thing which has come out of the sum total of all our endeavours in recent years. It is almost impossible to comprehend the progress we have made since 30 years ago I sat down to help make that first smoke control order in Birmingham, or 20 years ago when I first came to Parliament and sat down to take part in this first bill. Progress *can* be made and not least of the causes for self-congratulation is the fact that given all the creaks and the age and the difficulties of our democratic procedures, they *do* work if you know how to use them effectively, if you mobilise ahead of public opinion, and if you get local government and central government on your side. The encouraging thing is that people, and particularly young people, show every sign of not being satisfied with the progress that we have made and every intention of demanding more progress, even in these difficult days. Let us not disappoint them, but let us harness that enthusiasm and that determination in the next 20 years so that our children can enjoy, to an even greater extent than we have done, the environmental improvements to which they are justly entitled.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Summer 1976)** *which gave the position up to* **31 March 1976.** *They now show changes and additions up to* **30 June 1976.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

As from 23 September 1974, the distinction between "black" and "white" areas has been discontinued. Because of this, the table showing the smoke control position in regions of England has been temporarily discontinued.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Northern

Derwentside (Stanley No. 4); Stockton-on-Tees No. 5 (Albany Estate, Norton).

North Western

Bolton M.B. No. 3 (Bolton B. No. 49); Rochdale (Oldham Road).

Yorkshire and Humberside

Doncaster (Tickhill Nos. 3 and 4).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern

Carlisle Nos. 1-4; Halton No. 17 (Runcorn No. 12); Hartlepool No. 31.

North Western

Bolton No. 5 (Bolton B. No. 51); Liverpool No. 28; Trafford (Hale No. 6); West Lancashire (No. WL 2).

Yorkshire and Humberside

Doncaster No. 5 (Hexthorpe) and No. 6 (Hyde Park/Belle Vue); Leeds No. 3 (Morley West) and No. 4 (Carlton, Lofthouse and Thorpe); Wakefield (Hemsworth No. 1) and (Pontefract No. 10).

West Midlands

Bassetlaw (Worksop Area No. 5 Valley Road); Dudley No. 135 (Howne); Nuneaton No. 15 (Chilvers Coton); North Warwickshire No. 2; Warwick Nos. 4-6; Wolverhampton No. 21 (Finchfield).

East Midlands

Blaby No. 10 (Leicester Forest East and Kirby Muxloe); Gedling No. 4; High Peak (Buxton No. 2); Northampton No. 14; South Kesteven Nos. 3-7.

South Eastern

Gravesham No. 2; Oxford No. 17; Slough No. 17; Southampton No. 17 (Nicholstown).

London Boroughs

Bromley No. 26; Hillingdon Nos. 28 and 30; Merton No. 32.

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern

Castle Morpeth No. 1; Darlington No. 15 (Skerne Park); Halton No. 17 (Runcorn No. 12); Langbaurgh No. 3 (Grangetown North).

North Western

Hyndburn Nos. 36 and 37; St. Helens No. 11.

Yorkshire and Humberside

Craven No. 2 (Glusburn—Part); Rotherham (Kilnhurst, Kimberworth/Holmes, Rawmarsh No. 7, and Thorpe).

West Midlands

Birmingham No. 163; Dudley No. 135 (Hawne); Rugby No. 19; Stoke-on-Trent (Order No. 32); Warwick Nos. 5 and 6.

East Midlands

Ashfield No. 13; Blaby No. 10 (Leicester Forest East and Kirby Muxloe); Chesterfield No. 10 (Brampton and Boythorpe); South Kesteven No. 9 (Stamford No. 1).

London Boroughs

Waltham Forest Nos. 29 and 30.

South Eastern

Bracknell No. 6 (Central); Oxford No. 17; Thurrock Nos. 13 and 14.

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Craigavon B.C. Nos. 5 and 6.

NEW SMOKE CONTROL ORDER SUBMITTED BUT NOT YET CONFIRMED

Craigavon B.C. No. 4; Down D.C. No. 1.

SCOTLAND

NEW SMOKE CONTROL ORDER CONFIRMED BUT NOT YET IN OPERATION

Barrhead No. 5.

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Barrhead No. 5; Hamilton No. 5.

WALES

NEW SMOKE CONTROL ORDER IN OPERATION

Wrexham Maelor B.C. (Area No. 2).

SMOKE CONTROL ORDERS WITHDRAWN

Scotland

Lennoxtown.

South Eastern England

Slough No. 17 (withdrawn then confirmed for smaller area).

SMOKE CONTROL AREAS

Progress Report

Position at 30th June 1976

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).

	England			Wales			Scotland			Northern Ireland		
Smoke Control Orders Confirmed prior to 31.3.76	4,649			21			250			66		
Acres		1,526,063			2,912			136,533			16,087	
Premises			6,726,463			10,499			572,774			43,266
Smoke Control Orders Confirmed (31.3.76-30.6.76)	40			—			1			2		
Acres		16,375			—			141			24	
Premises			52,620			—			799			—
Totals	**4,689**	**1,542,438**	**6,779,083**	**21**	**2,912**	**10,499**	**251**	**136,674**	**573,573**	**68**	**16,111**	**43,266**
Smoke Control Orders submitted (31.3.76-30.6.76)	28			—			2			2		
Acres		18,645			—			579			418	
Premises			56,368			—			2,926			1,217
Grand Totals	**4,717**	**1,561,083**	**6,835,451**	**21**	**2,912**	**10,499**	**253**	**137,253**	**576,499**	**70**	**16,529**	**44,483**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

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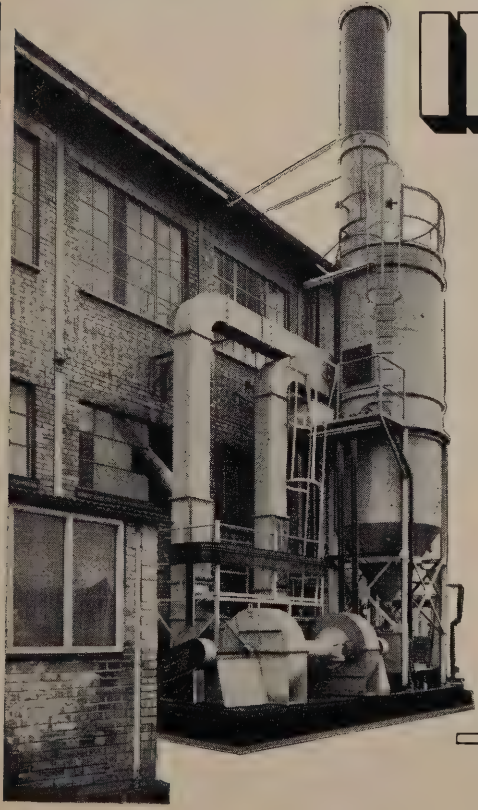

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Reader Enquiry Service No. **7648**

"Air Knows No Frontiers"

INTERNATIONAL NEWS

Argentina

The Association Argentina contra la Contaminacion del Aire announce the first congress on 'The City and its Environment' which will be held in Buenos Aires from 22-26 November 1976. Subjects to be discussed include: Urban Development, Urban Evolution, Urban Ecosystems and Urban Pollution. Further details from AACA, Cerrito 1250, Buenos Aires.

AACA have already started planning for the 5th International Clean Air Congress to be held in Buenos Aires in the spring of 1980.

France

On May 31st the President of the Republic received 20 representatives from the Association of the Defence of the Environment (which includes APPA and CITEPA). There should, he said, be an increasing amount of participation with private Associations in determining French environmental policy, and hoped that the 'structure for living European Assizes' would be held in France in 1977.

Equipment Ministers and Ministers for the Quality of Life, are pleased with the success achieved since February this year by the campaign against CO and CO_2 pollution from motor vehicles. The powers of the order actually arise from numerous controls on motor vehicles, but from 1st January 1977 these will sanction the stated infractions.

The Minister for the Quality of Life has announced the locations of the next five new special anti air pollution zones in large towns or industrial complexes. There are already similar zones in Paris, Lyon and Lille.

The annual reunion of the APPA Regional Committees took place in Grenoble on the 17th and 18th May in the presence of representatives of the Ministries for the Quality of Life and Health. The Association's policy for 1976/77 was decided, as well as the implementation of new automatic monitoring networks.

West Germany

The West German chemical industry invested over £158·5 m. in environmental protection during 1974. Nearly £39 m. went on air pollution control, over £104·5 m. on water purification, £2·25 m. on noise control, and nearly £13 m. on waste removal.

United States

The Environmental Protection Agency has proposed tougher emission standards aimed at reducing hydrocarbon pollution in a total effort to reduce urban smog. From 1979, petrol and diesel engine lorries and buses with gross vehicle weights of more than 8,500 lbs would be affected. The proposed standards approximate a 71-74 per cent reduction in hydrocarbons from current emission levels of petrol-driven vehicles. The additional reductions of CO and NO_x are estimated at 12-13 per cent each. The decrease in diesel engine emissions would be about 20 per cent and a lower level of smoke from accelerating diesels is also called for. By 1990, according to EPA estimates, the proposed standards would reduce annual nationwide hydrocarbon pollution by 0·6-0·7 m. tons; CO by up to 1·8 m. tons; and NO_x by 0·4-1·0 m. tons.

Australia

The Clean Air Society of Australia and New Zealand announce their sixth International Clean Air Congress to be held in Brisbane from 15-19 May 1978. Conference topics will include atmospheric science, health and the biological effects of pollution, pollution from motor vehicles, measurement and monitoring and control equipment.

Further details about the conference may be obtained from the Clean Air Conference Secretary, Clean Air Society of Australia and New Zealand, 484 Adelaide Street, Brisbane 4000, Australia. Those proposing to present papers should write to this address giving the title or subject of the proposed paper, preferably not later than February 1977.

India

The Taj Mahal is suffering from large amounts of sulphur dioxide discharged from nearby iron foundries and faces an even greater threat from a 6 m. ton capacity oil refinery, 40 miles away, which becomes fully operational in the early 1980s.

Japan

A new technology to remove simultaneously sulphur oxides and nitrogen oxides, which are said to be two major factors of air pollution, are being developed. It is generally believed that stationary sources of the two materials, such as factories and buildings, account for as much as 70 per cent of air pollution. The Environment Agency estimates that in 1975, factories alone discharged 687,000,000 m^3 of SO_x. For this, the agency has decided to make enterprises discharging the chemicals reduce their discharge, enforcing control on both SO_x and NO_x by their total amounts.

But the enterprises, which are bound to reduce them, have to install large preventive plants for each of the two substances. Nothing could be better if all pollutants can be treated by the same equipment. But practically this is impossible. Under such circumstances, SO_x and NO_x simultaneous removal technology is unprecedented. Already many companies see a definite prospect of its practical use.

Switzerland

PRO AQUA — PRO VITA 1977, the 7th International Fair for Environment Protection is to be held from 14-17 June 1977 in Basle. Provisional programmes for the accompanying technical meetings are available from: Secretariat Pro Aqua-Pro Vita, c/o Schweizer Mustermesse, Postfach, CH-4021 Basle, Switzerland.

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Reader Enquiry Service No. **7649**

Smokeless Zones—The History of Their Development

by

C. V. Malcolm, M.Sc.*

Part 1—The First 100 years (1830s to 1930s)

The burning of coal caused concern in the vicinity of London in 1648 when Parliament was petitioned to prohibit the import of coal from Newcastle(1). A few years later in 1661 John Evelyn wrote his celebrated "Fumifugium"(2), and argued the case for taking action to reduce smoke in the city of London. He made mention of its offence to persons, clothes and vegetation and addressed his remarks to the King who ordered them to be published. Evelyn's suggestions for reducing smoke included the use of wood instead of coal and the separation of smoke producing industries from residential areas with a vegetation barrier. A bill was prepared at Evelyn's instigation but never became law(3).

In a preface to the second edition of "Fumifugium" in 1772, White attributes a high proportion of the 50% mortality in children under two years to air pollution. As early as 1800 a nuisances committee appointed by the Commissioners of Police reported that smoke from various chimneys was a great nuisance(4). It was recognised even at this stage that industrial smoke could be greatly diminished. In 1819 a committee appointed by Parliament concluded it was practicable to prevent the emission of smoke in the burning of coal(1). Ashley has suggested that this marks the beginning of the long gestation period of the Clean Air Act 1956(5), and he has reviewed the history of air pollution control in London.

The Manchester Board of Health was reorganised in 1832, and local government reforms were made in the Municipal Corporations Act 1835(4). At this time Manchester was administered under the Court Leet. Richard Cobden served on a jury under this system and was so dissatisfied with proceedings that he circulated inhabitants. At the meeting that resulted a committee was formed to arrange a public meeting which was summoned in 1838 by the Boroughreeve and at which Cobden moved a motion for petitioning the Queen for incorporation(6). Petitions for and against were circulated, though many signatures to the latter were shown to be forgeries. The Privy Council ordered an Inquiry and within the same year (1838) the charter was granted and the first election took place.

Incorporation paved the way for changes in smoke nuisance control methods. In 1842 the powers of the police commissioners were transferred to the Borough Council and in the following year a nuisance committee was appointed for the whole Borough(4, 7) with responsibility for dealing with smoke nuisances(4). The Borough of Manchester pursued a policy of obtaining local act powers to enable more effective control of local conditions. Consequently, and in advance of national legislation, the Manchester Police Act 1844 included provision for the control of smoke nuisances by requiring furnaces used for trades and manufacture to be constructed so as to consume their own smoke(4). Owing to a shortage of timber for coffins green wood was being used but was charred prior to use. This process was a copious smoke producer and was covered by the new powers. (J. Lawson pers com). It became an offence to use a furnace negligently so that "the smoke arising therefrom shall not be effectually consumed or burnt", and in 1845 the Towns Improvement Company complimented the Borough for its anti-smoke proceedings "against powerful manufacturers"(7).

Smoke control was further facilitated in 1847 when a special nuisance inspector for the suppression of smoke was appointed(7). However in the same year the Town Clerk recognised a fundamental weakness in the law which, he said, ought to apply to the making of smoke not the construction of the furnace(8). He observed that smoke from house fires could only be stopped by using coke. Also in the 1840's a fire box which preheated the air to reduce smoke production was proposed. Nearly 100 years later in 1935 the Manchester Housing Commission put experimental coke burning grates in at Wythenshawe.

Select committees in 1843 and 1845 were appointed to consider smoke from furnaces and steam engines(3). It was concluded that present knowledge and experience was insufficient to make it desirable to extend powers of an Act beyond furnaces for generating steam(9). Sir Henry de la Beche and Dr. Lyon Playfair reported that "it cannot for a moment be questioned that the continued emission of smoke is an unnecessary consequence of the combustion of fuel," but that "it is useless to expect in the present state of our knowledge that any law can be practically applied to the fireplaces of common houses, which, in a large town like London, contribute very materially to the pollution of the atmosphere"(9).

As a result, clauses requiring furnaces and locomotives to consume their own smoke were included in

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* Mr Malcolm is Research Officer, Soils Division, of the Western Australian Department of Agriculture of Jarrah Road, South Perth, W. Australia 6151.

the Railway Clauses Consolidation Act 1845, and the Town Improvement Act 1847(3). The first Public Health Act was passed in 1848, during what, according to Meetham(3) was "the first part of a period of intense activity in the interest of public health, in which a leading part was played by Edwin Chadwick, a civil servant and a disciple of Jeremy Bentham." Nevertheless a smoke clause inserted in the 1848 Act by a Select Committee of the House of Lords was rejected in the Commons due apparently to pressure from "great chimney owners"(10). The major campaigner against the smoke clause was John Bright, the member for Manchester(5). It was queried whether smoke could be prevented and whether it was a hazard to health.

Nevertheless in Manchester in 1849 the smoke inspector took observations on 510 chimneys, cautioned 231 firms, served notices on 87 to improve their furnaces and summoned 19 of which 16 were fined and the remaining three withdrawn as work to lessen the smoke nuisance was in progress(7).

In 1854 the Report of the General Board of Health to the Home Secretary contained "evidence in favour of the suppression of the smoke nuisance"(8). This information was used by the Manchester/Salford Sanitary Association which made good use of the press and from 1856 on made repeated requests to the City Council to enforce the 1844 provisions more strictly for the sake of the working classes "in as much as they are compelled from the nature of their employment to live in the vicinity of the establishments where the smoke is produced." Perhaps the efforts of the Sanitary Association contributed to the strengthening of the 1866 Sanitary Act, which contained considerably strengthened powers for dealing with smoke nuisances, including an offence for the "making of smoke". In any case around this time the Association appointed two voluntary inspectors of its own to take independent observations of smoke from chimneys. By 1874 the Association had evidence that the 1866 law was extensively infringed and they urged the City Council to give full effect to the law(8). The Association commenced campaigning for the prevention of air pollution in 1852(11) and were still doing so over a hundred years later(12).

The 1863 Alkali Act and its successors will not be dealt with in this review.

Simon(8), speaking of Manchester claims that the Public Health Act 1875 did not increase powers over smoke. Meetham(3) however describes it as "the great Public Health Act" which superseded 22 earlier statutes and made important advances. Amongst these were the speeding of litigation, the placing of responsibility for public health administration on local authorities, and allowing the local government board to take proceedings if the local authority failed to do so. The emission of 'black' smoke in sufficient quantities to be a nuisance was an offence irrespective of means of abatement. Fireplaces and furnaces which did not as far as practicable consume their smoke were deemed to be a nuisance. Private dwelling houses were exempt. Any persons aggrieved by smoke could lay a complaint before a Justice of the Peace. For an active local authority such as Manchester, Simon's claim may be correct and he reports that the number of firms visited and warned peaked around 1876 and 1877. In 1878 the Noxious Vapours Abatement Association told the President of the Local Government Board that the Nuisance Committee was being very strict(8).

The activity of Manchester's inspectors notwithstanding, in 1881, Manchester's first "public officer of health" described the atmosphere as "the dark canopy which hangs as a pall over the city"(7). In the same year the City Council agreed to the appointment of additional smoke inspectors and to the reduction of the permissable smoke emissions from four minutes to one minute in one observation of half hour duration(7). The following year penalties were raised by the Manchester Corporation Act 1882(8). In 1883 it was reported to the Health Committee that there had been a considerable reduction in the amount of smoke poured out into the atmosphere(7). However, Simon(8) reports that the following year the energetic Manchester and Salford Sanitary Association had turned its attention to the need for playgrounds for schools. The Parks Committee had come under fire and indicated that the smoke nuisance was so severe that tree planting was almost a failure. This interesting observation offers a means of objective comparison of the condition of the atmosphere then and now. In 1975 the Director of Recreation Services told the North Central Area Consultative Committee that the improvement in Manchester's atmosphere was such that you could now grow virtually any plant.

A significant development in London was the formation in 1881 of the Smoke Abatement Committee with the object of reducing smoke from all sources, especially dwelling houses(9). Public meetings and an exhibition including improved grates were held. In 1887 the Smoke Abatement (Metropolis) Bill was introduced in the House of Lords to deal with smoke nuisances from private houses and premises not covered in the Acts of 1853-6, but it failed to become law. The first law passed to deal with domestic smoke was the Manchester Corporation Act 1946, 59 years later.

Green(13) has noted that central Manchester tended to develop during the second half of the nineteenth century as a commercial rather than industrial centre. The difference may explain why smoke control was more popular in Manchester than surrounding districts. It must also be remembered that in the 1860-90 period working people were given the vote and a major redistribution allotted electorates on a basis of population rather than property(14).

The activities of Manchester's smoke inspectors caused alarm amongst industrialists in adjoining towns when amalgamation was contemplated in 1889(7). They alleged that during certain operations the prevention of black smoke was virtually impossible. Procedures suggested by the industrialists to the corporation of Manchester were rejected as being in contravention of the Public Health Act 1875. A deputation in 1894 of the Chamber of Commerce protested at the use of a one minute in thirty emission standard. It was claimed rigid smoke inspection would drive trade away. Other local authorities were quoted as using no limit, fifteen, nine or five minutes. Periods of measurement of one week were suggested. It is interesting that later in the history of smoke abatement adverse comparisons of atmospheric pollution and progress in smoke control programmes between local authorities are used to promote greater control effort.

In 1886 the earlier (1847) conclusions of the Town Clerk about domestic smoke were reinforced by G. E. Davies who stated(15) that there would never be a coal fired domestic grate which could be smokeless under all conditions and that the remedy for domestic smoke was to use smokeless fuel. This claim was made in a lecture in Manchester and in 1891 the Noxious Vapours Abatement Association pressed the Gas Committee for cheaper gas and electricity. The increasing use of gas was urged as "one of the most feasible methods of lessening the present excessive pollution of the air by coal smoke." A Coal Smoke Abatement Society was formed in London in 1899.

There were further protests against prosecutions in 1897 and an eminent scientist tried to demonstrate that lower morbidity rates in some smoky districts demonstrated healthy properties in smoke. Graham(7) suggests that he was later converted as in 1912 he was appointed to the newly formed Air Pollution Advisory Board set up by the City Council.

Up to the turn of the century, therefore, there had been virtually no attempt to control domestic smoke. Methods of control were known to some extent but fuel supplies and prices were a problem, and domestic smoke was either less important relative to industrial smoke than it is now, and/or the significance of its contribution was not realised. Industrial emissions had been subject to control for many years but control related either to the emission of black smoke, except for permitted periods, or to the occurrence of nuisances. Attempts to reduce emissions were promoted by professional and amenity societies, and resisted by industrialists. Central government appeared to play a relatively minor role because air pollution had not become a national issue. The disadvantages of smoke were in general described in subjective terms and proof of health or other effects was lacking as a counter to the claims of industrialists that smoke was not a problem.

In 1910 following a joint (1909) conference of the smoke abatement societies of Glasgow, Sheffield and Manchester, a Smoke Abatement League was founded with headquarters in Manchester and E. D. Simon (later Manchester's Lord Mayor) as Honorary Secretary. The Local Government Board did not accept an invitation to be represented and discuss the formation of a Smoke Abatement Department under the Board's control.

Three years later a group of scientific and other societies presented a memorial to the Manchester Council(11) expressing concern at the "vast injury inflicted upon the community by the excessive pollution of the atmosphere by coal smoke, especially that emanating from domestic and office chimneys." In the memorial reform of air pollution was claimed to be of very high priority and experts offered their services gratis. The "enlightened disposition" of the responsible Departments was praised but it was felt there was a need of an "Air Pollution Advisory Committee" to assist the City with expert help and advice. The suggestion was adopted and an Air Pollution Advisory Board was formed as a sub-committee of the Sanitary Committee.

Also in 1912 an International Conference on Smoke Abatement was held in London and the "Committee for the Investigation of Atmospheric Pollution" was formed with representatives of the Smoke Abatement Societies and certain municipalities. The Air Pollution Advisory Board cooperated in the Investigation, and measurements by local authorities and other interested bodies commenced in 1914 in cooperation with the Meteorological Office.

1912 was a great year for initiatives in smoke abatement because arising from the International Conference, the Coal Smoke Abatement Society and the Smoke Abatement League appointed a joint Committee to draw up a new bill(16). During the second reading debate the President of the Local Government Board announced that he had determined to appoint a departmental committee to consider the whole question of smoke abatement. The Bill therefore lapsed.

The Corporations of many large Boroughs had forwarded to the Government in 1913-14 resolutions passed by them expressing the necessity of further smoke abatement powers against factory chimneys.

England was not the only area of activity in 1912. An exhaustive investigation of the costs of air pollution was conducted in that year in Pittsburgh, U.S.A.(17). The report formed the basis for a similar study in Manchester under the auspices of the Air Pollution Advisory Board. The report on the Manchester study, "The Black Smoke Tax" was issued in 1920 and in it was an estimate of the domestic washing costs in terms of hours of extra labour and price of extra soap caused by air pollution in Manchester as compared with Harrogate(17). The "Black Smoke Tax", as the cost of air pollution was called, was estimated to amount to 5,850,000 hours plus £183,000 per annum. It was observed in the study that "since everybody suffers, it is a long time before anybody protests. If the damage was done suddenly there would be a general outcry . . . Thousands of Manchester people live their lives from start to finish in the midst of black smoke, and have come to regard it as a normal condition of life." It should be remembered that is was only in 1913 that tuberculosis was seriously tackled by Manchester City Health Services(18). Another useful research area was covered by Fishenden(19) in 1920 with a detailed report on coal fires. Coal was shown to be the cheapest form of heating, and burning efficiency had a marked influence on economy.

A different approach to air pollution control was tried when in 1911 the Manchester Corporation's Electricity Department introduced a district heating scheme. Attempts to use district heating principles in housing estates after the 1914-18 war were eventually abandoned after encountering many difficulties(7). The Manchester Council received a protest from the Manchester and Salford Sanitary Association when in 1915 it proposed to increase the price of gas. The move, which was part of the Associations 63-year campaign for preventing air pollution, was unsuccessful. The Gas and Finance Committees held a joint meeting and the price was raised. Conflict within the Manchester City Council occurred early this century over treatment of refuse. The Public Health Committee repeatedly warned the Cleansing Department(10) and threatened legal action to prevent the dumping of organic matter on refuse tips without sterilising it. Eventually controlled tipping was adapted in the early 1920's. The Public Health Committee's campaign against the smoke nuisance is also alleged(10) to have "not always receive(d) its proper reward." The authors argue that the insistence of the Ministry of Health on the greatest economy hampered the work of the Manchester Council. The Ministry attitude probably exemplifies what Titmus(20) describes as the "Residual Welfare Model" of social policy, which holds that institutions should only provide social welfare when the private market and the family break down, and then only temporarily.

The Departmental Committee appointed in 1914 to inquire into "Smoke and Noxious Vapours Abatement" was suspended owing to the war and reconstituted with Lord Newton as chairman in 1920(21). In view of the interest and energetic policy of the Manchester Corporation and perhaps also because the Lord Mayor E. D. Simon was on the Committee it made its first visit to Manchester and received evidence from the Chairman of the Health Committee and the Medical Officer of Health, Dr. Niven(22). Works which had almost succeeded in abolishing smoke, as well as those for which smoke production was alleged to be inevitable were visited. Evidence of reduced daylight, high dust nuisance and predisposition to respiratory disease was presented to demonstrate the need for smoke abatement. Figures showing an apparent relationship between fog incidence and death in Manchester due to phthisis, pneumonia and bronchitis were presented. A case was made for including steam motor wagons in abatement legislation and for establishing Joint Boards with Ministerial Supervision to prevent nuisance from neighbouring authorities. The paucity of biological evidence available is demonstrated by the fact that 27-year-old data obtained by the Manchester Field Naturalists and Archaeologists Association on the effect of air pollution on plants was used in the report.

Suggested legislative changes were, increased penalties and the omission of the term "black" as applied to smoke. However this latter suggestion was accompanied by a three-tier definition of what a smoke nuisance was, and still included the word "black". Since domestic chimneys were recognised as responsible for at least half of the emitted smoke, "and that the most injurious half", it was desirable they should be subject to the law. "Fireplaces designed to consume a minimum of coal should be placed in all new houses and an effort made to get suitable fireplaces provided in existing houses." The Gas Committee should cease to be a profit making concern. Existing fireplaces could be limited as a first step "not to emit smoke for a period exceeding ten minutes in the half hour during any period after 9 a.m." Older children could be taught how to operate fires with minimum smoke on school fire-places.

The Departmental Committee was so impressed with the evidence it received from various sources on domestic smoke that it put out an Interim Report on 1st June, 1920(23). Perhaps the most compelling argument came from witnesses from the Housing Department of the Ministry of Health. The Ministry, they said, would welcome any assistance with the adoption in new houses being provided under their auspices, of smokeless methods of producing heat for the various services. The Committee recommended the adoption of smokeless heating in all housing schemes sanctioned by the Central Housing Authority. Gas and Electricity undertakers should be encouraged to cheapen their products instead of overcharging to allow relief of rates. Moreover, the Government should encourage research on the many outstanding problems of domestic heating.

After this promising start the Final Report(21) must have been a sad disappointment to those who had suggested extending control over domestic smoke. It concluded "after full consideration, we do not consider it practicable at present to propose legislation dealing with smoke from private dwelling houses." Smokeless heating for new buildings other than private houses was recommended. They noted with regret that the Ministry of Health had not followed the recommendations of their interim reports and reaffirmed them.

The Committee's approach to industrial smoke was to declare that "every manufacturer should take all practicable steps, having regard to all the circumstances of the case, to prevent the pollution of the air . . ." Questions of cost must be considered in regard to practicability. The safeguard they offered was that the Minister of Health should have power to fix standards for the whole country, or areas, or trades, after allowing manufacturers the opportunity to be heard. The law would apply to smoke of any colour. The Sanitary Inspectors Association was clearly disgusted with this outcome(24). The Committee had recognised that "best practicable means" was the downfall of present legislation but still left it in. Rowe, Sanitary Inspector for Manchester Corporation, told an Association Conference in Buxton in 1922 that it was not possible to obtain prosecutions against a technical defence on what was practicable. He was backed up by H. Dale, another Manchester Inspector, who said that prosecution cases were usually held in districts where those on the Bench were interested in the firms concerned. In such cases fines may be 2s. 6d.(24).

Perhaps two comments in the Committee's general conclusions typified its attitude:

"It is also clear that there is no bold or simple remedy which might appeal to the imagination and excite the enthusiasm of the general public."

and

"In the course of our investigations we have never ceased to bear in mind that the interests of trade must be fully considered, and that the introduction of legislation which might prejudicially affect important industries is quite out of the question."

Having failed to find a 'bold' solution, the Committee made a few half-hearted, placatory comments on the need for smoke abatement and deferred to industrial interests.

The most significant of its findings may have been the conclusion ". . . perhaps the chief factor in the failure to deal with the smoke evil has been the inaction of the Central Authority. No Government has, for many years, taken any action with the exception of appointing committees, whose labours have led to little or no result. Smoke and air pollution are, in our opinion, a national question, and we consider that it is useless to expect that it will be adequately dealt with by local authorities unless they are subject, when necessary, to the stimulus of Government. It is for this reason that we recommend that defaulting authorities should be compelled to act by the Minister of Health."

These strong sentiments may well have been included as a result of the Government's failure to act on the Committee's Interim Report. The rebuff may have served to dampen the Committee's enthusiasm or even to lead it to report in a manner calculated to stir up public agitation.

If the Government would not act on domestic smoke in its own housing projects why should industry be forced to do better?

In 1922 a Bill introduced in the House of Lords brought a sharp reaction from the Sanitary Inspectors Association(25). The Bill, in line with the Newton Committee's report, allowed the defence of 'best practicable means', which the Association claimed often totally failed in practice to deal with smoke nuisances. The best practicable means available may still result in real nuisance. Moreover dense smoke of any kind from a boiler was *prima facie* evidence that the best means of abatement was not being used.

Perhaps it is significant that when Niven(26) in 1923 published his "Observations on the History of Public Health Effort in Manchester" no section in the book was devoted to smoke abatement. It was recorded however that the Sanitary Department had at that time three smoke inspectors (it had one in 1847) and one Chief Smoke and Chemical Inspector. This may be compared with the current (1975) staff of 35, in the Clean Air Section, which is regarded as short of staff. It appears to be no coincidence that smoke abatement was not regarded as a major public health effort at this time. Simon(27) in 1926, the ex Lord Mayor, discussed the work of the Council. Under the work of the Health Committee, which had sub-committees dealing with drainage, nuisances and smoke abatement, the author discusses hospitals, venereal disease, infant welfare, tuberculosis, and insanitary houses and says he remembers nothing else in the work of the Public Health Committee worth reporting. Since Simon had certainly shown a great interest in smoke abatement his comments may be a reflection on lack of progress worth reporting rather than lack of activity. Indeed, also in 1926, the annual report of Council "How Manchester is Managed" included in the report of the Public Health Committee a newspaper report of rain so dirty meteorological officials had difficulty reading the glass(28) and the use of lights on cars and trams in the daytime in May. Useful research was nevertheless continuing and it was reported that a link between fog prevalence and respiratory disease had been established and the sun was reported to shine in Manchester only 60% as much as in southern suburbs.

In the 1920's the need to establish smoke abatement standards and procedures on a regional basis was "discovered" although the power to form joint districts was available for the purpose of the Public Health Act 1875(29). The advantages of uniformity and larger districts included prevention of adverse effects drifting from tardy districts and the possibility of a full time smoke inspectorate becoming available to small districts. The "sheet anchor of smoke prevention" however was still the 1875 provision that black smoke in sufficient quantity to be a nuisance, was a statutory nuisance, for which, best practicable means of control was not a defence. There was still no legal remedy for smoke other than black, and Rowe (Chief Smoke Inspector of Manchester) told a conference on Smoke Abatement organised in Manchester by the Smoke Abatement League in 1924, that progress on the domestic front depended on "a smokeless fuel within the reach of the humblest householder without delay,"(29).

Activity on the smoke scene was not all abatement. Rowe(29) also told the League Conference that unsuccessful attempts had recently been made to pass legislation which would have allowed exemption which would have "returned to the horrible state of smoke of 25 years ago". The legislation resulting from Lord Newton's Committee Report, which was produced after the war, was the Public Health (Smoke Abatement) Act 1926. This Act was a disappointment to the two societies that had had their own Bill before parliament around 1912(16). The Minister was given the power to extend exemptions with very little opportunity for debate, a provision which was not in the Committee Report. Des Voeux, the Hon. Treasurer of the Coal Smoke Abatement Society, told a conference in Manchester in 1928 that the Act "does not represent the considered views of those who have made a study of the smoke abatement problem". The Government had also flatly refused to let the act deal in any way with cooking or heating in new private dwellings. The Coal Smoke Abatement Society and the Smoke Abatement League had fought both these points and had supporters in both Houses of Parliament. The Ministry stated that they had not felt it possible to employ in Bye-laws any standard dealing with smoke that was not black in colour. Des Voeux noted "This is unfortunate because most smoke nuisances arise from smoke that cannot by scientific standards be shown to be black".(16).

In fairness to the Ministry it must be admitted that the proposals of the Sanitary Inspectors Association did not have a tidy simplicity which would enable easy legislation and uniform application. They had suggested in 1922(25):

"(a) That the phrase 'black smoke in such quantity as to be a nuisance' be held to mean black smoke of such density as that light cannot be seen through it as it issues from the chimney top, that such black smoke shall *per se* constitute a nuisance.

(b) That smoke of any colour or shade whatever of such density as that light cannot be seen through it as it issues from the chimney top shall *per se* constitute a nuisance.

(c) That where the smoke or fumes from a chimney, though not coming under the definition of dense smoke, constitutes as a nuisance . . . , like penalties shall be inflicted upon conviction.

(d) (re chimney heights).

(e) That where a chimney is found emitting dense black smoke or dense smoke of any colour or shade whatever for a period of two minutes in the aggregate in any half-hour, timing the bursts to half a minute, it shall be held to constitute an offence."

Provision (e) was to be subject to less stringent requirements in local authorities where smoke nuisance provisions had not previously been enforced. How much easier it was thirty years later to frame legislation based on the more objective assessments of the Ringelmann chart, even if it did emphasise colour rather than density, and to allow the creation of smoke control areas where *any* smoke not subject to an exception was an offence. The Ringelmann chart, which was produced in the nineteenth century, has the practical disadvantage of not being able to be used at night. Moreover experienced observers could match the chart's results within about half a shade. Therefore, although it was not especially significant to the practical inspector, it was eventually recognised by those framing the law as a basis for specific measures. Even so it was unlikely to be used in practice to obtain convictions because its use entailed actions which would attract attention (J. Lawson pers. com.).

The Central Government was also criticised in 1924(29) for the failure of the Local Government Board to deal with local authorities which failed to implement smoke abatement provisions. The merger of Local Government with the Ministry of Health would, it was hoped, result in more active steps. The Minister of Health in fact addressed a meeting of 167 representatives of 78 local authorities in Manchester Town Hall in 1924. As a result it was decided to form a permanent Joint Committee to consider, primarily, uniform procedures for smoke abatement. An Executive Committee was formed and circulated a questionnaire to all the authorities. More than half the districts had only the most casual inspection if any at all, and only two had full-time inspectors. Time concessions for black smoke emission varied from 2-12 minutes in a half-hour. This was in spite of the declaration of the Newton Committee that little or no smoke need be produced by boiler furnaces. A report circulated to all authorities and recommending uniformity of action and full-time inspectors was replied to by less than half, of whom eight said yes, two were doubtful and 33 said no. Actually the population of the eight exceeded that of the rest but the Executive Committee recommended that "the question of a ' united area ' would have to be dropped till further educational work had been done among those smaller authorities". Instead an advisory body, the Manchester and District Regional Smoke Abatement Committee, was formed with one guinea from each authority to cover expenses. The Committee worked actively, published booklets and in 1929 joined forces with the Smoke Abatement League for propaganda and to organise classes for stokers and boiler-men.

Fishendon's study on the coal fire was followed up by the Air Pollution Advisory Board of Manchester City Council in 1927 with a study of domestic grate designs aimed at minimising smoke. Pointers were given on how to burn coal efficiently and reduce smoke and it was concluded than an inexpensive firegrate design which gave no unburnt products was needed. It was commented that smokeless fuel did the job but "unfortunately this process has not yet achieved the commercial success that would make the fuel available to everyone"(30). In 1927 at the request of local authorities the DSIR (Department of Scientific and Industrial Research) accepted responsibility for co-ordinating local observations of atmospheric pollution and for carrying out research into the nature of atmospheric pollution and the best methods of measurement(1).

The 1930-31 winter provided good epidemiological evidence for an air pollution—disease link: In December 1930 there were 137 respiratory disease deaths and no fog. In January 1931 with nine days of heavy fog, 592 deaths were recorded(31). Bennett, Medical Officer of Health for Manchester discussed his experiences in private practice at a conference of the National Smoke Abatement Society in 1931. This Society arose from an amalgamation of the Smoke Abatement League and the Coal Smoke Abatement Society in 1929. Bennett spoke of the unnecessary severity of illnesses and the number of deaths caused by the impure smoky atmosphere of Manchester, compared with adjoining country areas. Public opinion was, however, still largely apathetic towards the problem which could not be solved until its gravity was understood(32). The reason smoke abatement lagged behind other health reforms was according to Simon (8) that although it killed, it killed slowly. Whereas polluted water killed quickly and wholesale fear had led to the successful tackling of diseases such as cholera and smallpox, although Manchester had a higher death rate from respiratory disease than the rest of the country, public opinion was not yet alarmed.

As active districts experienced the benefit of their smoke abatement policies they also became more acutely aware of smoke blowing from recalcitrant neighbouring authorities' areas. Consequently, growing public interest (as evidenced by a petition to the Minister of Health to make the Regional Committee a Statutory Authority(33)) justified another attempt to get joint action. The half-yearly conference of the Regional Committee passed a resolution in 1930, and in 1931 local authorities' representatives attended a conference organised by Manchester's Lord Mayor. A resolution calling for the formation of a joint board under the Public Health Act 1875 was agreed to in principle (96 for and 24 against). The Officials of the Advisory Committee assisted by the Manchester Town Clerk prepared a draft scheme. The scheme was agreed to by the Regional Committee in 1931 but owing to the depression it was postponed. In 1935 the case for the Joint Smoke Abatement Board was updated. It emphasised the tremendous disparity in occurrence of black smoke emission in Manchester compared with 33 other areas. Black smoke was emitted more than 25 times as often in the other districts and in Manchester 70·2% as against 4·9% elsewhere were less than two minute emissions. Health effects including respiratory disease, cancer, rickets (due to reduction in sun) and TB (worse, due to less sun) were quoted. Work by the Industrial Fatigue Research Board showing that work output was reduced when lighting was bad were mentioned. Cleaning costs were quoted and data were given for reductions in steam raising costs or of coal consumption in 30 boilers in nine different sorts of works as a result of smoke abatement. It was stated to be an impossibility for Sanitary Inspectors to handle smoke abatement as a part of other duties. Full-time smoke inspectors were essential(33). The case showed the benefit of many years of experience and a variety of lines of research drawn together to make a reasonable argument supported by objective data. The action of the Regional Committee was strongly supported by the 1931 conference of the National Smoke Abatement Society, "Smoke Abatement on a Regional Basis". At the conference five papers dealing with the work of the existing Regional Smoke Abatement Committees (one of which was statutory) were read(33). The 1935 report estimated that the Joint Smoke Abatement Board would cost not more than one-ninth penny rate from each authority. However, the threat and outbreak of war prevented further steps being taken.

The second part of this article, entitled "The Development of Smokeless Zones, 1934-1958" will be published in the next issue of Clean Air.

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Part 1 Table 1

PROGRESS IN DOMESTIC SMOKE CONTROL IN MANCHESTER UP TO 1927

(Events not originating in Manchester are bracketed).

Date	*Method*	*Measure*	*Source*
(1661	Substitute wood for coal	suggestion (Bill)	Evelyn)
1847	House fire smoke can only be stopped by using coke	Report	M/C Town Clerk
1840's	Fire Box to reduce smoke by preheating air	Proposed	M/C Public Health Off.
(1843	Laws on furnace smoke can't extend to common houses	Report	Select Committee)
(1875	Private dwellings exempt	Public Health Act 1875)	
(1881	Reduction of dwelling-house smoke	Smoke Abatement Committee formed London)	
(1881	Domestic smoke to be a nuisance	Smoke Abatement (Metropolis) Bill not passed	House of Lords)
1886	Remedy for domestic smoke is smokeless fuel	lecture	Govt. Insp. of Chem. Works
1891	Cheapen gas and electricity	Pressure on M/C Gas Committee	Noxious Vapours Abatement Committee
1913	M/C need for help and advice, domestic smoke stressed	Form an Air Pollution Advisory Board	Group approach to M/C Council
1920	Coal gives cheapest heating and efficient burning is vital	Research report	Fishenden
1911-1920's	District heating schemes	Tried but abandoned as a measure	M/C Council
1920	1. Put special grates in new houses; 2. Try to change grates in old houses; 3. Make Gas Committee non-profit; 4. Restrict smoke from existing fireplaces; 5. Educate children on smoke control.	Submission to Newton Committee	M/C Health Committee
(1920	1. Put smokeless heating in Housing Authority schemes; 2. Cheaper gas and electricity; 3. Encourage research on domestic smoke.	Interim Report	Newton Committee)
(1921	Legislation on private dwelling smoke not practicable	Final Report	Newton Committee)
1924	Smokeless Fuel needs to be cheaper	Talk at Conference	Smoke Abatement League
1927	1. Grate design to minimise smoke; 2. Efficient operation of grates; 3. Inexpensive grate design needed; 4. Smokeless fuel not a commercial success.	Study Report	M/C Council Air Pol. Adv. Bd.

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BOOK REVIEWS

Hydrogen Sulfide Removal from Gases, Air and Liquids

Pollution Technology Review No 22 by Paul A. Ferguson. Noyes Data Corporation, New Jersey, US, and London. Pp 349 × x. Price $36

Hydrogen sulphide or sulphuretted hydrogen is a poisonous gas with an unpleasant odour. The tentative limit concentration in a factory atmosphere as given in the document published by HMSO for the Ministry of Labour is 10 parts per million by volume or 15 mg/m^3. Large quantities of the gas are produced as a by-product in the purification of natural gas, petroleum and in gas made from the carbonisation of coal. Fortunately for the British Gas Industry, there is very little hydrogen sulphide in the gas obtained from the North Sea. In the natural gas obtained in large quantities in the south of France there was 15% of hydrogen sulphide by volume, which was removed and used in the production of elemental sulphur. There is also a considerable amount in the gases from petroleum wells in certain areas in the Middle East. The reviewer dealt with the gases from a petroleum well in Iraq which contained 11% to 12% of hydrogen sulphide. Except for sulphur occurring as such naturally, hydrogen sulphide is the largest source of world supplies of sulphur. It is obtained from hydrogen sulphide by partial combustion to convert about one-third of the sulphide to sulphur dioxide, followed by treatment of the mixture of the two gases in a Claus kiln, usually in the presence of a catalyst, whereby the sulphide and the dioxide interact to form elemental sulphur and water vapour.

The book, however, is not intended as a detailed description of the methods of treating hydrogen sulphide as at present used on a large scale to produce sulphur. It is mainly a detailed description of processes covered by about 200 US patents on methods of purification of hydrogen sulphide obtained from the various sources. It would be interesting to know how many of the processes described in the US patents are in commercial operation; the probability is that the number is very small. The book will be of value mainly to inventors and industry considering patent applications in this field of science and technology as it will greatly ease their work in searching and studying the US patents of interest to them.

A. Parker

Air and Water Pollution

edited by W. E. Brittin, Chairman of the Department of Physics and Astrophysics, University of Colorado, Ronald West, Professor of Chemical Engineering at the University of Colorado and Robert Williams of the University of Michigan. Published by Adam Hilger Ltd, 613 pages, price £10

The book comprises the proceedings of a conference held at the University of Colorado in August 1970 and the papers provide a survey of the present state of the various physical and biological disciplines related to air and water pollution. As such, the book embodies the best principles of specific thought at that time, but suffers, as all such books do, from the fact that it is a collection of papers by a number of very different authors on varying subjects. Nevertheless, the volume does try to deal with the underlying basic research problems in air and water pollution and points out that these are problems to which physical and biological scientists can make a real contribution. This, therefore, does tend to be a book for scientists, and scientists who are specialists in particular fields.

Part 1, dealing with water, covers such subjects as the kinetics of biological processes used for waste water treatment, the disposal of waste water concentrates, cultural eutrophication: the nature of the problem and some recommendations for its study and control, to chemical problems in metal toxicity and the effect of water pollution on stream life, to mention only some of the papers. In Part 2, where air is under consideration, the range of subjects discussed stretches from photochemical pollutants and photochemical aspects of air pollution through radioactivity and the stratosphere to atmospheric pollution in growing communities, measurements of aerosols in the atmosphere, and the possible uses of global atmospheric models for the study of air pollution.

Remote Sensing—Energy-related studies

edited by T. Nejat Vaziroglu, Director of the Clean Energy Research Institute of the University of Miami. Published by John Wiley & Sons, 491 pages, price £22·00

This book comprises the papers presented at the Remote Sensing Applied to Energy Related Problems Symposium held at Miami in December 1974. The lecturers and authors, selected from among the leaders in this new and growing field have endeavoured to cover both fundamental information and the latest developments. In this respect the book is very up-to-date and the various papers are well set out. What is perhaps more important and which is found only rarely in such volumes, there is a good subject interest included.

Remote sensing involves the use of surface, airborne or spacecraft instrumentation capable of scanning large areas of the earth, the oceans and the atmosphere. It is, therefore, of particular interest to those concerned with data and information processing, with telecommunications and electronics, with systems and control engineering and, of course, environmental studies. In the latter case the volume contains information about remote sensing of thermal pollution of air and water, and the remote sensing of meteorological conditions.

The book is well produced and is essentially one of reference for university and industrial libraries.

Waste Not Want Not—Air

written and illustrated by Anne-Marie Constant. Burke Books, 1976, 32 pages, £1·30 (library ed), 95p (hardback), 80p (limp)

A brightly illustrated book for children aged between seven and nine years. The emphasis is on 'the air we breathe' and the interaction between human and plant respiratory cycles is explained clearly in words and pictures. The author is Canadian, but the facts presented are not inappropriate to the British situation. The only lack is that no reference is made to smoke control, an integral part of air pollution control in this country.

We gave the book to a bright seven-year-old to read; many of the words had to be explained by her mother. When the book was read in a class of seven-year-olds, with explanation from the teacher, it proved to be a starting-point for further interest in science and nature studies. Older children will probably enjoy reading the book for themselves.

Unfortunately, although half the book is headed 'And now. What must we do?', there are few practical experiments suggested. There are warnings about safety with plastic bags, shutting oneself in an enclosed airless space, burning rubbish or playing with gas, but these seem out of tune with the general theme of the book, in which children of different colours disapprovingly observe the sources of atmospheric pollution.

A sententious approach may lead children to condemn air-polluting habits; as our teacher remarked "I'm sure the message will be going home about flysprays". But no fundamental changes are indicated, and little positive action within a child's scope. Parents might disagree with the suggestion to 'sleep with the windows open' if the air pollution is as bad as the book earlier suggests. The author does not explain that most pollution occurs in the daytime. On the other hand, the suggestions to go into the country, and to take part in open-air sports, will be appreciated.

A great many points are packed into this book; the air is a difficult topic to tackle simply, but with the aid of large, clear pictures and text, the author has succeeded in conveying the importance of her subject.

Selected Methods of Measuring Air Pollutants

published under the joint sponsorship of the United Nations Environment Programme and WHO. Geneva, WHO, 1976 (WHO Offset Publication No 24), 112 pages, $8·00. From HMSO

This manual was prepared as part of the WHO programme on air quality monitoring in urban and industrial areas. It is intended to be of practical use to laboratory workers world-wide, even to those unfamiliar with some or all of the procedures. It provides a critical view of the most widely used methods of measuring air pollutants; it is not a comprehensive survey of all available methods. This restriction has been made so that the selection of the most suitable method in each case should be as simple as possible.

Measurement methods are considered for five pollutants: suspended particulate matter, sulphur dioxide, carbon monoxide, oxides of nitrogen, and oxidants. To each of these a chapter is devoted. After a simple introduction to characteristics of the pollutant which it is desirable to consider in selecting a measurement method, the principles, advantages and limitations of the selected methods are outlined. The bulk of each chapter comprises a detailed analysis, with many diagrams, of procedures to be followed in each method. Apparatus to be used is described. In the case of such simple apparatus as high volume s.p. samplers, engineering specifications and instructions are provided in text and diagrams. Where the apparatus would necessarily be equipment on a commercial scale, its essentials are described, with a note of additional services to be expected from the manufacturer. A reference on performance specifications and test procedures is also given. Sampling and analytical procedures, and calibration, are detailed, with calculation formulae given as required. A thorough and logical system of numbered sub-headings ensures a rapid, easy comparison between methods. Detailed references are given at the end of each chapter.

The final chapter in the manual is a standard guide for air pollution data processing and reporting, prepared by WHO. It is hoped that this will encourage the adoption of a standardised format by countries so as to facilitate the transfer and comparison of air quality information from country to country. Specimen forms for reporting the results of analysis and site identification are included. The manual was prepared with the assistance of an impressive list of scientific advisors, and in co-operation with the WHO collaborating centres of the US EPA and the Medical Research Council's Air Pollution Unit. It should become an invaluable tool of reference for many workers concerned with air pollution.

Housing, the Housing Environment, and Health

an annotated bibliography by A. E. Martin, in co-operation with F. Kaloyanova and S. Maziarka, WHO Offset Publication No 27. WHO, Geneva, 1976, 120 pages, $7·20

In this bibliography, "housing" has been interpreted in the widest sense to include dwellings, their immediate environs and amenities. Research reports on the epidemiological aspects of housing are very scattered; this compendium provides summaries of a comprehensive collection of publications on the subject. Considerable emphasis is placed on environmental studies, with air and water pollution well represented. Air pollution inside houses is included, with a selection of annotations on the medical effects of acute air pollution episodes such as those of London and New York, and on the chronic effects of air pollution on respiratory diseases. No attempt is made to cover the pollution from industry or from motor vehicles.

References drawn from sources world-wide include some of the extensive eastern European literature resulting from the requirement upon health and housing administrations in these countries to lay down specific environmental standards.

A selection is made from material dealing with polluted water supplies and poor sanitation, although the wider aspects of water-borne communicable disease are not covered. Several studies on noise are also included. The bibliography should prove a useful work of reference for the libraries of both environmental health and housing departments, as well as for researchers in the subject.

Reducing Pollution from Selected Energy Transformation Sources

Chem Systems International Ltd. Graham & Trotman Ltd, for the Commission of the European Communities, 1976, 230 pages, £7·50

The report presents the results of a study carried out by Chem Systems, under a contract with the Commission of the European Communities, to evaluate and compare measures to reduce pollution caused by energy production. Sources covered are (i) Stationary: power stations, large steam-raising plants for industrial use (over 100 tons per hour steam), district heating plants, municipal incinerators, and oil refineries; (ii) Mobile Sources: motor vehicles, trains, and aircraft.

Pollutant emissions from both stationary and mobile sources are surveyed. The major pollutants assessed are sulphur dioxide, nitrogen oxides, particulates, carbon monoxides and unburnt hydrocarbons. A table gives the summary of fuel consumption estimates for 1970, followed by separate tables for each pollutant. Factors in compiling these tables are noted. Control and abatement methods available for each pollutant are summarised in separate sections.

A section of the report analyses the cost of pollution reduction. Attention is concentrated on the problem of sulphur dioxide pollution in the case of stationary sources, as this is considered the most important pollutant, and the one where the number of technical options available is the greatest.

There are several books-worth of gleaned knowledge within this one report. A particularly useful examination is made of the technical means for sulphur dioxide abatement, covering fuel desulphurisation, fuel conversion processes, modified combustion techniques and flue gas desulphurisation processes. Under these headings the various processes are discussed, with a description of the method, an assessment of its efficiency, its by-products, and advantages. The analysis on mobile sources examines the effect upon total emissions from road vehicles of two alternative scenarios, one assuming further penetration of diesel engines and the other assuming a major swing to stratified charge engines after 1980.

In addition, the report recommends that, as very attractive pollution reductions and energy savings could result from a rapid development of combined heat supply and power generation schemes, further study on district heating criteria is necessary. Technical and economic parameters and cost factors which apply at present energy prices should be established. Quantitative estimates of present and potential applications should be provided, with an analysis of the institutional problems involved.

Nitrogen Oxides Removal

by W. H. Lewis. Published by Noyes Data Corporation, 287 pages, price $36

This very informative and detailed book is based on United States patents issued since 1960 that deal with the removal of oxides of nitrogen. It serves a double purpose in that it supplies detailed technical information and also is a guide to the US patent literature in this particular field.

The contents and subject index are logically and well arranged. First the conversion of automobile exhaust gases by catalysts is dealt with and this is followed by a section on catalytic converter design. The next section discusses the means of treating automobile exhausts by non-catalytic means. The book then moves on to consider catalytic conversion of industrial stack gases and then sorption techniques for the removal of the oxides of nitrogen and flue gases. Liquid scrub processes and combustion and oxidation techniques for treating gas streams form the next two sections, then the recovery and utilisation of nitrogen oxides from commercial processes and air purification, analytical techniques and other processes complete the volume. As this book deals with US patents, there is an index of inventors and an index of US patent numbers.

The book is well produced but we feel that it only has a limited appeal, namely to those engaged in work in this particular field.

Atmosphere-Surface Exchange of Particulate and Gaseous Pollutants (1974)

US Energy Research and Development Administration. ERPA Symposium Series CONF-740921. Available from the National Technical Information Service, US Department of Commerce, 1000 pages, $16·10 (foreign, paper-bound)

The volume contains the proceedings of a symposium held at Richland, Washington, in September 1974 under the joint sponsorship of Batelle, Pacific Northwest Laboratories, and the Division of Biomedical and Environmental Research, US Atomic Energy Commission. The 58 papers form a compendium on atmospheric removal by dry deposition and insertion rates by resuspension. Much of the research has been directed toward predicting the behaviour of inadvertent emissions from nuclear facilities, but particle motion basically is not controlled by particle toxicity; thus even the nuclear research results apply also to non-nuclear emissions such as fossil-fuel particulates and gaseous sulphur emission. An index is included.

The Electricity Council Annual Report 1975/76

During 1975-76 the electricity supply industry in England and Wales made a small profit of £8·5 million after payment of £424·5 million in interest charges. This is a dramatic improvement on the losses of £265·3 million in 1974-75 and £184·1 million in 1973-74 and shows that the industry is returning to the profitable position it achieved during the first 21 years of its history following nationalisation.

The financial outcome of 1975-76 is a modest improvement on forecasts made at the beginning of the year, in spite of the fact that the volume of electricity sales was less than had then been expected; this in part reflects the successful efforts being made throughout the industry to increase efficiency.

The losses which the industry suffered during the preceding five years were largely a result of Government policies of price restraint. During this period the industry was prevented from recovering fully in electricity prices the very substantial increases in the costs of fuel and other supplies required for electricity production and distribution. The Electricity Council have consistently pointed out that the costs of supply have to be recovered from the industry's customers or from the nation's taxpayers, and that in the country's interests the right course is to allow the prices charged for electricity to reflect the full costs of its supply.

The substantial improvement in the industry's financial results reflects progress made towards the objective stated by the Chancellor of the Exchequer in November 1974

> "to eliminate subsidies to the use of energy through artificial prices for the products of nationalised industries".

Pursuing that objective has meant increases in the prices charged for electricity, and the initial impact of these increases has been sharpened by the need to catch up on the very large cost increases of recent years. Since 1972-73 the cost of fuel has increased by 146% and the cost of the other materials and services used in electricity production and distribution has increased by 82%.

Sales of electricity in 1975-76 were 3·3% less than in 1974-75. The reduction can be attributed to the combined effects of the general economic recession, diminished industrial activity, increased prices and the Government's "Save It" campaign, complemented by the industry's advice to customers to use electricity wisely.

One consequence of the fall in demand is that a number of old power stations or parts of stations with relatively high production costs and low thermal efficiencies are no longer required for generation. Agreement was reached in October 1975 for immediate and formal 12 months' notice of closures to be given for 23 power stations and 18 parts of stations.

British Gas Corporation
Annual Report and Accounts 1975-76

The British Gas Corporation recorded a consolidated profit of £25·1 million in 1975-76, after depreciation and interest payments. The profit represents 1·6% on a total turnover of £1,565·6 million. This was welcome, following deficits in the two previous years, but still falls short of the level required to build up adequate reserves. The Corporation considers that the industry's reserves, only £84 million at March 31, 1976, should be built up to about £500 million by 1980.

Major factors were an increase in gas sales of 4%; an increase of 1·54p per therm (from 8·17p to 9·71p) in the cost of gas; and of 2·03p per therm (from 7·85p to 9·88p) in the average income from gas. Capital expenditure in 1975-76 totalled £346·6 million (£238·7 million in 1974-75). A high level of investment was needed for the extension of the national gas transmission system.

The Corporation's campaign to improve its own use of energy has resulted in savings during the year of nearly 4 million therms of gas, 108 million Kw/h of electricity, and 436,000 gallons of petrol.

Courses at the British Gas School of Fuel Management at Solihull have been attended by over 1,000 directors, managers and supervisors from industry, and their response has been most enthusiastic. Regions have backed up the school's activities with local courses and seminars.

Gas is playing an important role in energy saving in the domestic market where surprisingly fuel use has been virtually static since 1963 despite higher heating standards and an increase of 2·7 million in the number of homes. This is due almost entirely to the fact that gas, which is more efficient in terms of primary energy usage than most other fuels, increased its share of heat supplied in the domestic market from 10% to nearly 40%. Natural gas now supplies 17% of the UK demand for primary energy. In terms of the amount of heat supplied to final users, the gas industry share of the market is 27% and, in the domestic sector, gas is the leading fuel, supplying 40%.

A new daily record for gas supply was established on January 29, 1976, of 5,992 million cu ft. Total gas available in 1975-76 was 14,346 million therms, an increase of 654 million therms (4·8%) over the previous year.

Supplies of gas from the Rough Field to Easington began in October 1975. Deliveries were received from 30 production platforms in the North Sea. Production from the Indefatigable area has reached plateau level. The groups in which the Corporation participates for exploration and development carried out further survey work, the drilling of exploratory and appraisal wells and installation of production platforms during the year.

Solid Smokeless Fuels Federation Annual Report 1975-1976

A combination of three factors produced unusual results on the domestic solid fuel market during 1975-76. These factors were the increase in the price of all types of fuel, the very mild winter and the "Save It" campaign of the Government which, in the event, was quite successful. The combined effect of these events was a reduction in the sale of solid smokeless fuels but an increase in the sale of solid fuel appliances, in particular the open fire. During the year there was a marked increase in the cost of metered fuels which was reflected in the high quarterly bills which came as a shock to many people. Events have shown that many households prefer to meet their expenditure for fuel over shorter periods now that costs have increased, hence the demand for solid fuel appliances for which fuel can be purchased easily and frequently and the desired economies achieved. The approved open fire, particularly the open fire with back boiler, meets the requirements of most families. In addition to radiant heat it provides cheap hot water and the free heat gained from the chimney passing through bedrooms makes it even more attractive.

The lifting of hire purchase restrictions on space and central heating installations, together with the industry's campaign to "Open up your Chimney" also helped in generating the sale of new appliances.

Another approach was made to the Department of the Environment and the Scottish Development Department asking that they advise local authorities not to give a grant to replace approved open fires in new smoke control areas. At its meeting in February, the Clean Air Council accepted a recommendation made by the Department of the Environment that approved open fires should not be replaced under grant in new smoke control areas and it is anticipated that local authorities will be so notified in the near future.

Along with other organisations in the industry, the Federation continued to press for the inclusion of flues in new houses. The realisation that a flue passing through the centre of the house is a constant source of heat is now accepted by many architects and is influencing house design. To publicise this point, the Federation made a new audio visual presentation 'The Sixty Year Investment' which outlined the advantages of building a flue in new houses. This was shown on numerous occasions to Local Authority-elected representatives and officers.

Due to the success of the few agricultural shows in which it participated in 1974, the Federation decided to purchase its own marquee in 1975. In co-operation with the Solid Fuel Advisory Service, stands were taken at seven agricultural shows at which cookery demonstrations were given. In addition a new mobile exhibition was put into service to replace an old vehicle that had been in use continuously since 1963.

The overall availability of solid smokeless fuel during 1975-76 was very good, with the exception of certain types of Welsh anthracite. The production of anthracite was affected by delays in obtaining planning permission for new opencast sites. The National Coal Board dealt with this problem by assisting in the importation during the winter of sufficient equivalent anthracite from Europe, America and the Far East to safeguard the home market and making it available to the public at a price as near as possible to that of Welsh anthracite. Sufficient supplies of Coalite, Rexco and Sunbrite were available to meet market demands while Homefire, with its smaller production capacity, was always in demand.

The run-down in steel production, the reduced export demand and the lower domestic consumption of solid smokeless fuels affected the demand for hard coke. This was responsible for the closure on 31st October 1975 of the two coking plants owned by NCC Coke Ltd, namely the South Yorkshire Chemical Works Ltd and the Barnsley District Coking Co Ltd. Great efforts were made by NCC Coke Ltd to save the plants, unfortunately without success.

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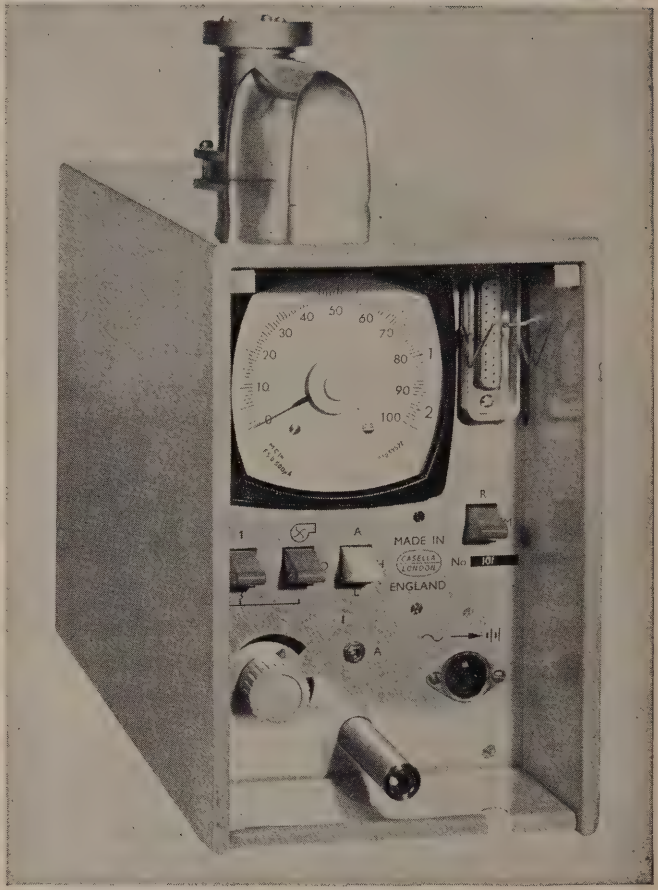

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District Heating and the Forces of Change

by

B. Manifold M.Sc., M.E.H.A.

Environmental Health Department, City of Manchester

A paper presented to the North West Division of the National Society for Clean Air at Preston on March 2nd 1976.

1. INTRODUCTION

The twentieth century has seen the age of explosions when rates of increase have been exponential and unprecedented not only in terms of energy consumption but also in the context of demography, the depletion of natural resources and even knowledge.

World increases in population will place greater emphasis on the number of houses required, which in turn will create even greater demands on fuel and electricity, the necessity for high density developments and the continued sprawl of urbanisation. While this results in increased levels of pollution and a steady exhaustion of fossil fuel supplies, an enlightened and educated public has aggravated the position even further by demanding improved heating standards, a greater degree of automation and a sophistication of design.

District heating provides inherent advantages not only with reduced condensation, lower operating costs and a continuous uniform supply of heat beyond the Parker Morris Standards but also with the benefits of energy conservation and reduced levels of air pollution. In 1968 at the World Energy Conference, district heating was recommended as being the best method for conserving fuel and reducing air pollution.

No scheme so far has been abandoned purely on economic grounds—and that is basically still the method of judging the feasibility of proposed district heating schemes—and even then economic externality factors such as waste disposal and clean air are not included on any financial balance sheet.

In pursuing the luxuries of a modern society with an economy of flow rather than one of stock, environmental factors which are external to the concepts of modern economics have been disregarded. To maintain a true high standard of living in the future, a reassessment of the profound qualities of life is required with a move towards alternative technologies that have a much lower impact on the urban environment. However, the problems of air pollution and limited resources will not be resolved either by an industrial recession or a state of no-growth. An effort must be made to utilise and maintain in good operating condition the preventive means which already exist whilst at the same time searching vigorously for new techniques of production which themselves economise on energy and materials.

District heating in its simplest form is merely an extension of individual central heating techniques with the transmission of thermal energy via a heat medium from a central heat source to a distant consumer network. The transmission of thermal energy is a form of "telethermics"* in the same way as the supply of electricity and gas are methods of distributing energy over long distances between producer and consumer.

District Heating Schemes

Basically there are two main types of district heating scheme in operation. Firstly, the block or group heating scheme which forms the basis of those systems found in the United Kingdom and, secondly, the long distance or real district heating scheme, so called because it operates on a much larger scale by utilising "waste heat from electricity generating stations and municipal incineration plants". It is normal procedure to plan a group heating scheme around a predetermined housing estate or redevelopment area. Such schemes are relatively small, heated by large automated central heating boilers burning fossil fuels and are limited in distribution capacity to a mains pipeline length of about 70 kilometres with a consumer network totalling about 3000 units. In contrast the real district heating schemes are generally much larger and provide heat from a multiple range of sources and locations. These schemes are alleged to be more economic and able to extend up to and beyond 225 kilometres in length and have the potential to provide space heating and hot water to more than 500,000 dwelling units. They are widely used on the continent and located extensively in the East European countries such as Russia and Czechoslovakia.

A district heating scheme can be considered as consisting of three main sections:

1. The heat generation system.
2. The distribution network.
3. The consumer network.

Each of these sections is important in determining the costs of any scheme but whilst wide variations in the choices of method of heat generation and fuels are possible, and those choices can significantly affect costs, they are generally of secondary significance to the costs of the distribution network. It is therefore almost invariably the distribution network occupying between 33 and 50% of the total costs—which determines the economic viability of a scheme. Equally the principles adopted in the other two sections are those which help to provide not only individual consumer advantages but also the altruistic benefits of a low-impact technology in harmony with the urban environment.

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* A term originated by A. E. Haseler, of the Department of the Environment. It denotes the transmission and distribution of thermal energy.

2. FUNDAMENTAL TYPES OF HEAT GENERATION

Conventional Boiler Plant

Large boilers burning gas, oil, coke or coal to heat the circulating medium may be shown to conserve energy and reduce air pollution. Block or group heating of this type is very popular in Denmark and is gaining increasing significance in W. Germany and Britain. Most current schemes now employ hot water raising boilers with high load factors normally around 75% of the maximum continuous rating. The heat medium is transmitted as hot water at 90-120°C under pressure through underground heating mains commonly of the pipe-in-pipe system which is itself designed to reduce the heat loss to a minimum, i.e. 7% in the heat distribution network.

The pipe-in-pipe system was adopted in the group heating scheme at Bretton, Peterborough, where hot water from four natural gas-fired boilers raising 44 megawatts (150 million Btu/hr)) is transmitted through a mild steel inner pipe separated from the outer PVC pipe by a packing of polyurethane foam insulation. Heat losses in this scheme were assessed at only 3% of the total heat load.

The growing popularity of these schemes is indicated with the report that 14% of all local authority houses under construction in 1975 were connected to a district heating scheme of some kind. However, as seen in Table 1, the overall picture in comparison with other European countries is less than adequate.

At present Manchester has three group heating schemes that are either operative or under construction. The Moss Side district heating scheme is an example where low sulphur oil-fired boilers provide heating to a total of 640 dwellings, a sports centre, market hall and shopping precinct. The scheme formed part of Manchester's redevelopment programme and also maintained air hygiene standards in a manner superior to smoke control area procedures based on the use of similar types of fuel.

Heat and Power Stations

Traditionally the concept of establishing district heating schemes was based on the interplay between the generation of electricity and the generation of heat in power stations. Conventional condensing power stations can, at best, only achieve efficiencies around 35% while district heating power stations, otherwise known as thermoelectric stations, are able to raise this level to 75%, and even higher with gas turbines. Combined heat and power stations thus involve a change of technology from condensing steam turbines, to back pressure or pass-out steam turbines in which steam is allowed to expand but is released at a higher temperature and pressure—normally above 121°C and between 14-30 psi—compared to the conventional turbines releasing steam at around 38°C and 0·6 psi. The change in technology provides a higher level of usable thermal energy at the expense of the generation of power such as electricity. A fundamental explanation of this fact is understood when considering the enormous heat potential in the latent heat of steam. By using the intermediate take-off condensing turbine (ITOC) which is a development of the back pressure turbine, advantage may be taken of fluctuating heating loads, or low electricity demands, by altering the pressure flow of steam from the turbine so that when the heating load is low the total flow of steam can be directed towards the low pressure side of the turbine to generate mainly electricity. The steam released at a higher pressure is normally passed through heat exchangers to the circulating secondary hot-water system in the district heating scheme. This type of scheme has not been popular in Britain mainly due to the attitude of the CEGB towards ensuring a copious and continuous supply of electricity for the national grid by the cheapest means available—a method which has not, particularly in view of the merit-order classification of power stations—made full use of the principles of total energy. However, the CEGB maintain that even in the present economic situation the installation of thermoelectric stations is not feasible in their current programme and

TABLE 1 DISTRICT HEATING IN VARIOUS COUNTRIES

	Percentage of all dwellings with central heating			Percentage of all dwellings district heated		
COUNTRY	1960	1970	1975 (Projected)	1960	1970	1975 (Projected)
DENMARK	27·6	55·5	54·5	13·8	27·8	40·9
SWEDEN	74·0	79·8	79·9	—	15·2	16·6
FRANCE	(1967) 28·4	—	40·9	(1967) 12·6	—	21·6
GERMANY	10·9	32·1	41·1	0·6	3·4	4·2
BELGIUM	10·7	20·9	27·8	1·1	5·5	7·4
UNITED KINGDOM	6·7	30·7	44·5	—	0·3	0·9
NETHERLANDS	6·0	17·1	26.3	VERY SMALL		

that while successes have been gained abroad these have been primarily due to the long cold winters and the policy of parochial generation and consumption of electricity in these countries.

Municipal Incineration Plant

Municipal incineration is another method from which heat may be recycled for beneficial purposes. Municipal waste as a fuel for district heating stations can be converted from a form of pollution into useful energy and can itself be related to a saving in the consumption of fossil fuels. Heat supplied from refuse incineration can supply at least 10% of a town's heat load as in the Paris scheme. Such schemes are, however, dependent upon the ratio of areas district heated to those of rubbish collected and the calorific value of the refuse which is generally accepted in Britain to be around 4500 Btu/lb. Mørch estimated in 1968 that the refuse collection area should be 24 times the heat distribution area. The heat load of the district heating scheme must be such as to be capable of utilising the total heat production from the incinerator plant during the summer months and it is usual for stand-by plant in the form of oil, gas or coal-fired boilers to meet the additional fluctuating demand. Accordingly, the heat obtained from the refuse is designed as a base supply for meeting the thermal load requirements in summer. However, in practice it is very difficult to obtain complete balance between heat production and the connected consumer load and figure 3 shows the proportions of useful and rejected heat during the year for a typical plant of this nature.

There are over 30 district heating refuse incineration plants in Scandinavia, many of them being of modern and successful design. Many others also exist in Europe, such as Paris, Berne, Rosenheim, Hamburg, Vienna and Nottingham, all of which produce heat and electricity. The Eastcroft Nottingham incinerator can dispose of 23 tonnes of refuse per hour from a population area eleven times the size of its heat distribution network. It is also provided with three coal-fired chain grate stokers each serving a marine water-tube boiler with a maximum continuous rating of 45 million Btu/hr. The plant is designed so that coal provides 45% of the annual fuel consumption and so that in 1980 the combined heating plants will provide about 130MW (440 million Btu/hr) for 6,000 dwellings.

Other Sources

While there are obvious drawbacks to the siting of nuclear heat producing stations particularly in close proximity to high density developed areas, the use of fission reactors in a district heating scheme can and has proved successful. In Sweden the Agesta experimental nuclear station in Farsta, Stockholm has been operating successfully since 1957 in underground caverns, generating a total of 65MW of heat and 8MW of electricity by the heavy water, natural uranium method. Heavy water leaves the reactor at 220°C where it is circulated to heat exchangers which generate steam at 214°C to drive the back pressure turbines and feed the district heating network (see figure 4).

On a less frequent basis the concept of district heating has also provided a beneficial utilisation of heat from geothermal sources as in Reykjavik, Iceland, where in 1970 a scheme provided heat for 8,700 of its 10,000 houses serving around 72,000 consumers. Natural hot water is pumped to the surface from deep underground sources, transported under pressure at 119°C to a deaerator in the main pumphouse in order to remove gaseous nitrogen and then through the distribution network to the connected consumers.

3. ENERGY CONSERVATION

There is a close relationship between the gross national product and the national level of energy consumption (see figure 5). This normally implies that any measures towards energy conservation mean a reduction in the standard of living, which is unacceptable to the majority of the population. District heating on the contrary provides a method for the conservation of energy which is both practicable and socially acceptable. The Department of the Environment estimated that district heating could at the moment result in a 5% saving in fuel consumption while Pincott in 1973 stated that Britain wasted the potential heat in 1,000 million gallons of oil or 6·2 million tonnes of coal every year in the disposal of refuse which could otherwise have been recycled as a type of low calorific value fuel. Furthermore, in 1973 it was estimated in Russia that all the district heating schemes then in operation were providing an overall saving in fuel consumption of about 15% per annum when compared with individual appliances which was equivalent to 78 million tonnes of 'reference' fuel (ie fuel with a calorific value of 7,000 Kcalories/kilogram).

The concept of increasing thermal efficiencies in large central heating stations thereby reducing fuel consumption has provided a simple technique for the conservation of energy in domestic, commercial and industrial applications. The fundamental objective of such applications with this method is to translate the maximum fraction of the fuel's inherent potential energy into a high beneficial utilisation factor. As an example, it was found that all the dwelling houses in one particular town consumed on average the equivalent of 8,440 Gigawatt* hours per annum when converted to full central heating systems by individual boilers. Subsequently it was estimated that if all the dwelling units were connected to a district heating mains instead of being heated by individual appliances, the town's total fuel consumption would have been reduced to the equivalent of 6,200 Gigawatt hours with direct thermal plants or to 4,460 Gigawatt hours with the utilisation of heat from thermoelectric stations.

On the basis that the production of one kilowatt of electricity requires approximately 3·5 to 4 kilowatts of oil, coal or gas and considering the large number of buildings heated by electricity in Britain, the time may now be right for introducing legislation to control or dissuade the use of this form of thermal energy for space heating. The conservation of fuel in Russia as in other countries due to the centralisation of heat sources is determined by the differences in efficiency between the district heat source and the individual appliances with a correction for thermal losses in transmission through the distribution network. The differences in fuel consumption between the two types of systems were estimated at about 20% in favour of district heating when coal was burned and 15% when natural gas was consumed. Furthermore, when thermoelectric stations were compared with electricity generating stations the fuel saving amounted to approximately 25%. In Moscow 13 natural gas fired thermoelectric stations help to provide district heating to nearly two million flats and in 1971 it was estimated that the incorporation of such stations replacing individual appliances saved three million tons of fuel. While it is

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* 1 Gigawatt = 1,000 million watts or 10^9 watts.

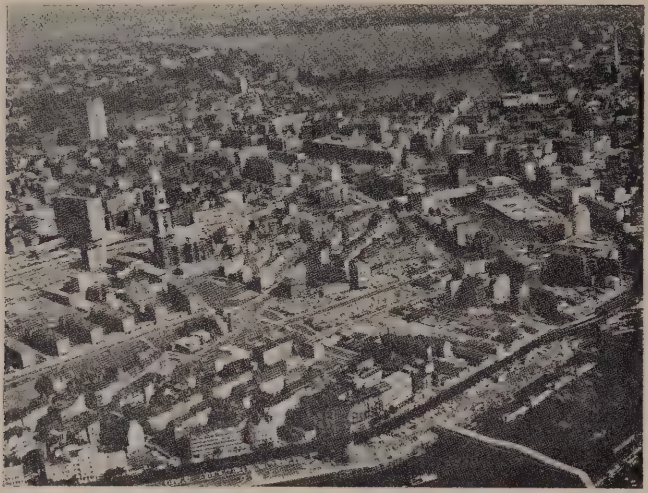

Fig. 1 Hamburg. (The R. Elbe in the foreground). The city centre consumer network which in 1968 was the largest district heating undertaking in W. Europe. Three power stations and a municipal incineration plant provide an annual heat supply of 11.4 × 10^{12} Btu which is transmitted as hot water and steam through a mains pipeline length of 311 kilometres. With the exception of the harbour region where industrial steam is needed, the central area is supplied with hot water through a 2-pipe (supply and return) ring main system about 6-8 miles in diameter. (Gräfe).

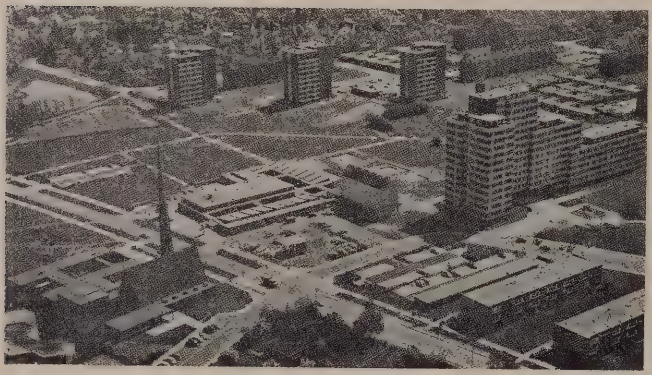

Fig. 2 Hamburg—Rahlstadt. A typical group heating scheme with conventional gas fired boilers situated in the 'toast rack' building with the 'satellite' blocks of flats and low rise dwellings in close proximity. Hot water is circulated at 110°C through underground pipelines to a total of 1400 dwellings. (Gräfe).

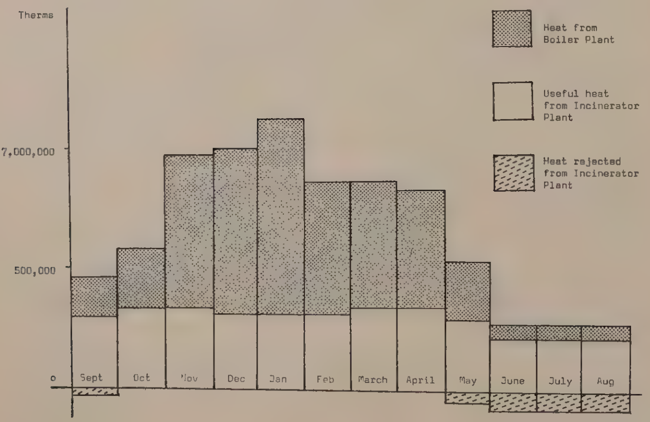

Fig. 3 Heat Production Balance in a Municipal Incinerator District Heating Scheme (Mørch 1968).

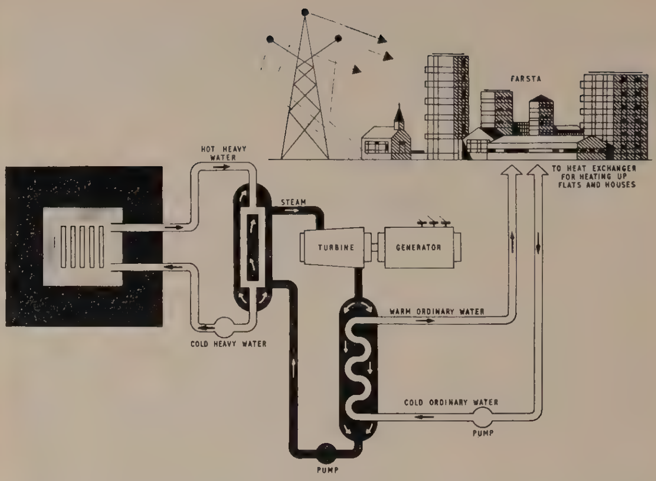

Fig. 4 The diagrammatical layout of the nuclear power district heating scheme in Stockholm (Diamant). Reproduced by courtesy of Iliffe Books Ltd, London.

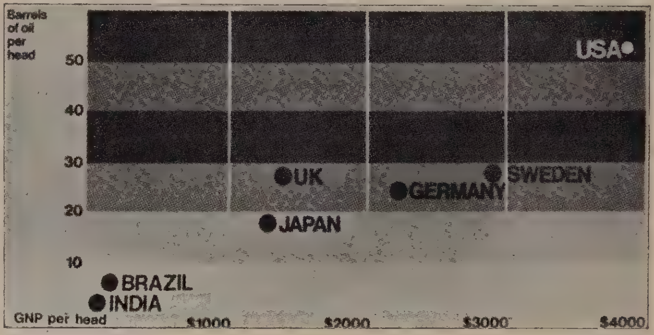

Fig. 5 Energy consumption rises with GNP (Pincott 1973).

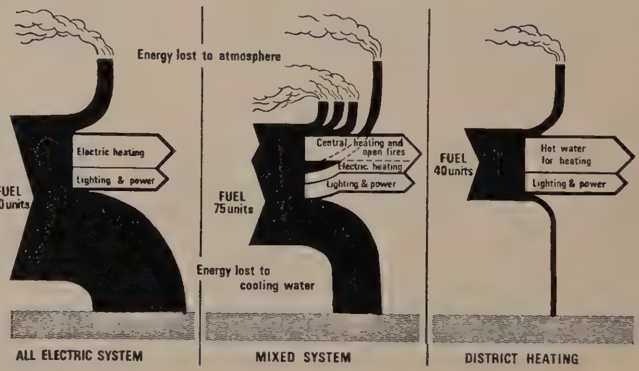

Fig. 6 An illustrative diagram to indicate the conservation of fuel and consequently running costs with "real" district heating for supplying an equal energy load for domestic services. The figure on the left indicates the level of fuel consumption when all the energy requirements are transmitted as electricity. The "mixed" system is the situation virtually operative today with individual appliances, electrical space heating and some group and block heating. The district heating illustration depicts the relative level of fuel consumption for the supply of heat and electricity from thermoelectric stations, and the consequent reduction of air and water pollution. When considering the mixed system operating today we must consider what the increased costs to the consumer are of maintaining stable levels of pollution comparable to those produced by district heating (H. Harboe).

reported that discount rates for buying bulk, cheap, fuel are more limited today, the benefit of using the low grade fuels and other sources of thermal energy such as geothermal heat remains a distinct advantage, particularly in view of the relatively more simple task of changing to an alternate type of fuel in the event of a wholesale change of energy policy or economic circumstances. As fuel prices continue to rise in the foreseeable future, energy will become more valuable creating an even greater significance for district heating and a more meaningful cost-in-use analysis.

4. ENVIRONMENTAL IMPACT

Pollution is a ubiquitous, primarily artificial resource, out of place and unlimited by temporal boundaries. In accordance with thermodynamic principles not all energy is usable and as the entropic state of any process increases, so the amount of available energy from the source becomes less while the environment becomes increasingly burdened with process wastes. Consequently the more fuel and energy that is consumed by a process, the greater the impact on the environment (see figure 6). District heating must be acknowledged as a beneficial form of urban heating with inherent environmental advantages such as reduced levels of air pollution, not only due to incorporated standard design factors but also due to improved combustion efficiencies and the adaptability of such systems to utilise heat from the earth's crust, municipal incinerators, pyrolysis plants and nuclear power stations.

The basic concept of reduced levels of air pollution lies in the construction of large centralised heating plant with tall chimney stacks to replace a multiplicity of small, less efficient heating appliances connected to low level flues. The installation of large boiler plants also provides the feasibility of including some type of gaseous and particulate arrestment facility as well as the practicability of siting the building in a remote place less likely to give rise to local nuisance.

District heating as a matter of policy has provided considerable reductions in the concentrations of smoke and SO_2 from domestic and commercial premises in many European countries including Russia, Denmark, France, Sweden and W. Germany, just as smoke control areas have provided a similar level of success in Britain. However, while both systems have caused reductions in ground level concentrations due to the *quality* of emissions, district heating provides the additional advantage of lower *rates* of emission. On the basis of fuel consumption and heating load requirements Hammer (1973) compared the emissions of sulphur dioxide in Berlin from separate furnaces and combined heat and electric power stations. He found that with similar heating capacities of 100 Gigacaloris per hour the total heat generation for combined heat and power stations and individual appliances was 20 G. Calories/hour and 90 G. Calories/hour respectively with a resultant emission of 60 kilograms and 240 kilograms per hour of sulphur dioxide.

Furthermore, in Sopporo City, Japan, it was estimated that the introduction of district heating to replace individual appliances would improve SO_2 levels in the city centre by 50-60% and 70% on the periphery of the city (Akagi and Malfitani 1972). This was achieved with the construction of a chimney stack 295ft high on the district heating station and cyclone dust arrestors which limited emissions to below 0·09 grains/cu ft.

Winkens reported in 1970 that the generation of 900,000 G. calories per annum in district heating schemes in Mannheim, which was equivalent to the consumption of 810,000 tonnes of fuel oil burned in individual appliances previously installed in the town, would result in the effective reduction of SO_2 emissions by approximately 18,000 tonnes per annum.

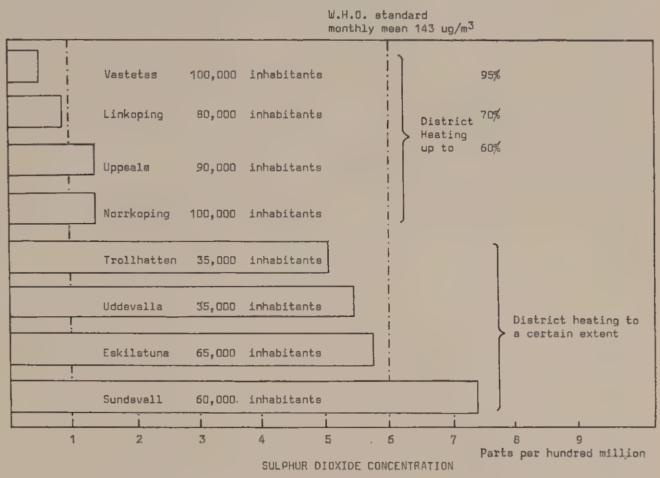

Fig. 7 The correlation between District Heating and Sulphur Dioxide levels in Swedish Towns.

Margen (figure 7) was able to demonstrate the effectiveness of district heating in February 1971 with the reduction of sulphur dioxide levels below the World Health Organisation recommended monthly mean of $143\mu g/m^3$. This was illustrated in Vasteras, Sweden, where 95% of the housing stock was connected to district heating schemes and where monthly SO_2 levels averaged less than $25\mu g/m^3$. In contrast other Swedish towns with far lower levels of district heating such as Eskilstuna and Sundsvall were shown to have average monthly SO_2 values in excess of the recommended limit.

The significance of reducing airborne emissions at source was illustrated in Hamburg where larger concentrations of SO_2 were recorded at heights of 20 metres, 90 metres and 150 metres above ground level in a commercial and industrial area. Thus gaseous dispersion formulae regulating the heights of chimney to minimise ground level concentrations would in such cases not provide the same air hygiene standards for people occupying the top floors of tall blocks of flats as they would for those living in ground-floor premises.

A notable and progressive feature of large cities and high density residential and industrial developments are "heat islands" where isothermic infra-red photographs are able to distinguish particular areas of waste heat emission. While thermal pollution of the atmosphere has not caused any extensive deleterious effects on the urban atmosphere, environmental problems have been caused by the thermal effluent from power stations. The electricity generating plants in the USA produce 75% of the heat dissipated into watercourses. By raising the temperature of the water, eutrophication occurs and the natural ecology of the affected area downstream is changed. Normal planktonic life such as diatoms and green algae which are an integral part of the food chain for fish, are killed, and as conditions worsen, the flora and fauna of the river gradually changes allowing thermophilic organisms such as blue-green algae (cyanophyta) to thrive and colonise large stretches of the watercourse. Ultimately oxygen depletion may occur resulting in anaerobic conditions with the decomposition of plant life, fish morbidity and the assimilation of methane and hydrogen sulphide in the river mud. By adopting district heating turbines in power stations the occurrence of thermal pollution from condensing towers and cooling water is obviated and a consequent visual affrontation is also removed.

By constructing waste disposal plants such as municipal incinerators, a form of waste heat recovery system may be operated which when connected to a consumer network not only provides a pecuniary advantage to offset the current average cost for incineration of £9 per tonne of refuse but also provides an ideal method of transforming an abundant type of pollution into a beneficial use. However, judging by the number of such schemes now in use in Britain compared with those operating in Europe the theoretical analogy of "Middens to Midas" would appear in practice to lack that certain golden touch!

CONCLUSIONS

District heating provides a technological solution to localised heat problems as well as a logical and improved harmony with the environment. Not only is there a high utilisation of the total energy in fuel with a consequent pro rata decrease in fuel consumption but also the efficient transmission of thermal energy enables heat from municipal incineration, industry and the earth's crust to be put to beneficial use.

Among the plethora of possibilities, district heating is put forward as one solution to urban heating which combines the personal benefits of improved heating standards, automation and convenience with altruistic principles befitting an alternative technology such as energy conservation and a lower level of environmental impact.

Whilst proposed schemes will continue to be limited by economics with a cost-in-use analysis, many opportunities have been lost since the war to incorporate district heating into redevelopment and improvement programmes for local authority housing. The time is now right for a reappraisal of urban heating on a national level with the consideration of the full benefits available from district heating.

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Letters to the Editor

Dear Sir,

In the Spring issue of 'CLEAN AIR', we have read with interest M. P. Paterson's article on 'The case against unrestricted access to National Survey Data'.[1] If the title of the paper were to be taken at face value, then a case for the restriction of access to National Survey data would be expected. Given the essentially public nature of the data, both from the point of view of the cost to the nation in collection and the fact that the measurements and co-ordination are largely (if not entirely) carried out by government agencies, restriction of access would be unthinkable. Fortunately, this is not what is proposed in the text. It is suggested that an up-to-date core of validated data should be established for purposes of more serious research, but without altering the present method of access.

Indeed, the premium file is a fine concept. As a physical chemist, one of us has for many years laboured long and hard in an endeavour to have students develop a feeling for the value of the numbers they manipulate. The precision and accuracy of measurements and their consequential utility is as fundamental to National Survey data as it is to student laboratory experiments, and furthermore, we acknowledge Dr Paterson's broader experience in the area of air pollution which has enabled him authoritatively to state the particular need for assessment of the reliability of the National Survey data. As he has pointed out, it would take considerable insight and familiarity with the National Survey to be able to distinguish the reliable data from the doubtful and the task would seem most appropriately to fall at the feet of the Warren Spring Laboratory co-ordinators in conjunction with the Local Government operatives. However, our recent experience has indicated that Local Authorities are often dependent upon their public health personnel for manpower for the National Survey and that their resources are clearly limited in this area; explicitly by a well-defined budgetry item. In addition, in times of greater concern for the environment, pressures arise for systematic measurements to be made of other atmospheric contaminants relating to motor vehicle emissions and for the monitoring of noise levels, to say nothing of the expanding concern with the other areas of the environment. In short, Local Authorities may well find themselves in the position of having to close down some National Survey stations in order to provide other services. A decreased commitment to the National Survey of smoke and SO_2 seems more likely than the reverse. While the battle against smoke and SO_2 is far from concluded, the above situation could well be aggravated by the feeling that the point of limiting returns is rapidly being reached in the current phase of control of emissions, that in many ways the National Survey has done its job and perhaps should be run down to a skeleton operation. Even now, a quick glance at National Survey publications will show this running down to have been in process for a number of years.

Similarly, one would imagine diversification of activities, limited resources and the present funding arrangements of the Warren Spring Laboratory would all mitigate against the co-ordinating body undertaking a heavy involvement in the creation of a so-called premium file (the extent of usage of which would be difficult to gauge in advance) unless of course, additional funding could be found for the project. In the current financial climate, how likely is this? We would all agree that if such a file were to be created it must be done carefully and done well. It is possible that a project of this type would have to receive at least partial funding and/or manning from alternate sources to those currently running the National Survey, requiring a special fund, raised perhaps by contribution from those who would seek to be users of the file. It is not intended to be a facetious suggestion of involvement of those such as Dr. Paterson who feel they can see a clear need for selection of data, or who may well be capable of the diagnoses required or who may well be potential recipients of some direct benefit in their personal research. Surely if the need is so great, then the process of creation of the premium file is a sufficiently worthwhile and rewarding project in itself, albeit a demanding one and one likely to be fraught with tedium.

One wonders, however, to what extent the proposed premium file would be used, and in the light of this, whether the time and effort would be justified. From the standpoint of scientific research it would certainly be convenient to have an extensive file of relevant validated data ready prepared along with a multitude of carefully and systematically selected support information. But is this not a large component of what the scientific research is about? Is not the attainment of or the selection of data a result of the conceptual design of the investigation? Would not the compilation of such a file presuppose (i) what is representative, (ii) which is critical and which is not, (iii) the areas of which are likely to be of most interest and (iv) to some degree the essential elements of any analysis? We recognize that both the format and content of the suggested file are generally sensible and that the latter was open-ended. However, given the large number of categories of sites into which the WSL co-ordinators have seen fit to create and the infinite array of meteorological, geographical, biological, medical and sociological factors of possible relevance—to say nothing of the relative significance of other monitored pollutants—we feel that the creation of such a file almost requires answers to a large number of the questions which we would presumably be hoping to obtain from later use of the file. It seems we have the old ‘chicken and the egg’ situation. We reiterate that a less grandiose attempt to create a premium file of information would still require so much expertise and manpower to be of questionable value for occasional and unpredictable use. We would agree with the assertion that only minuscule usage has so far (and will probably ever) be made of the massive amount of information collected, but we believe that the deployment of a substantial section of the limited resources available to this suggested compilation could be more wasteful than some possible gross errors that may otherwise eventuate. In any case, have not other areas of science developed in spite of erroneous data, interpretation and theories? And are not the recognition and understanding of these mistakes often the hallmarks of progress? A more major undertaking involving not only assessment of reliability of data and compilation, but detailed analysis as well, would seem a more readily justifiable and worthwhile venture.

A further point that we feel of considerable importance is related to items (i) to (iii) above and concerns the choice of subject for investigation. For some years now, one of us (A.J.L.) has at Brunel, been studying a wide range of local environmental problems in the London Borough of Hillingdon, including those of air quality. The research was directed principally towards the investigation of odours, associated with organic manufacturing processes and with the Heathrow airport. Our interest in air pollution in the LBH has recently led us to consider the National Survey data collected locally. We are hoping that a useful job may be done locally and also that some small contribution may be made to the overall understanding of air pollution as a whole. It would only be fortuitous if the data that we are analysing would be found in the “premium file” and we would not expect it to be there. The LBH encourage us in these studies, assisting in data retrieval and discussion, trusting that our results will be of value to them. It is our belief that more research should be done for the local environment on a co-operative basis. A premium file is unlikely to be of more than nominal use to us and to others of a similar inclination. We have obtained a magnetic tape of the most recently available National Survey pollution year data. We would hope that data from neighbouring and more distant areas would not be refused and unrestricted access to the whole body of data, by the results obtained, ultimately be profitable to the community at large.

Yours faithfully,

R. F. Cross* and A. J. Lacey†
*Departments of *Industrial Chemistry*
and †Applied Biology,
Brunel University, Uxbridge.

Dear Sir,

In the Summer 1976 issue of ‘Clean Air’ there was a paper on ‘Atmospheric Lead Pollution’ which contained a statement deserving some comment. The author, Mr. Pollitt, appears to have misinterpreted the brief report of work carried out by the Environmental Protection Unit of Birmingham Environmental Department.

To clarify this matter it is important to note that the data published by the Environmental Protection Unit show wide variations in lead concentrations according to different types of sampling area and clearly these cannot be interpreted as showing lead to be deposited with dust reasonably uniformly. What our work does show, although perhaps this is not explained in sufficient detail in the report, is that airborne lead is distributed uniformly throughout the City. Consequently, on this basis alone a uniform deposition of lead would be expected. However, particle size effects on sedimentation together with localised sources and transportation mechanisms superimpose their effects on the overall situation to give rise to the observed distribution.

We agree with Mr. Pollitt that measurements of lead in dust are data that must be treated with considerable caution and we have described our work together with criticisms of the sampling and other parameters in a paper that is in the press.

Yours faithfully,

A. Archer
City Environmental Officer,
City of Birmingham
Environmental Department,
120 Edmund Street,
Birmingham B3 2EZ.

NEWS FROM THE DIVISIONS

NORTHERN

Fifty-eight members including the Secretary General, attended the Annual General Meeting of the Northern Division which took place at the Municipal Offices, Middlesbrough, on Friday, 28th May 1976.

As two nominations had been received for the offices of Chairman, Honorary Secretary and Treasurer, and a Divisional Representative to serve on the Council, it had been found necessary to hold a ballot. Councillor T. W. Yellowley, M.B.E., of Newcastle upon Tyne was appointed Chairman, and Mr C. R. Cresswell Honorary Secretary and Treasurer as well as Divisional Representative. The vacancy for Vice-Chairman created by Councillor Yellowley being appointed Chairman was filled by Councillor L. Poole, B.E.M., J.P., of Middlesbrough.

The retiring Chairman, Councillor L. Poole, and Honorary Secretary and Treasurer, Mr L. Mair of Newcastle upon Tyne, were thanked for the excellent work they had carried out on behalf of the Division—in the case of Mr Mair this stretched back over some 20 years, during which period he had served for 15 years continuously as Honorary Secretary and Treasurer. Members were pleased to hear that Mr Mair will continue his association with the Northern Division after his retirement as Director of Environmental Health at Newcastle, firstly as a private member and secondly as a member of the Divisional Council.

After appointing the remaining 14 members who will form the Northern Divisional Council, a short discussion ensued on Circular 54/76 dealing with revised grant arrangements for smoke control areas. Members from those authorities who had nearly completed their smoke control programmes disliked the Circular as they saw its proposals making enforcement more difficult and problems arising in the apparent withdrawal of freedom of choice in the use of fuels. The meeting passed a resolution that the Council be requested to ask the Department of the Environment to withdraw or, at least, amend the Circular.

The meeting ended with a talk given by Mr C. M. Davis of the Environmental Control Unit of the British Steel Corporation. Mr Davis, with the aid of slides, treated members to a brief but comprehensive review of the main sources of pollution in an integrated iron and steelworks and the current levels which techniques to minimise emissions had reached. He explained the ever-increasing cost of pollution control, now assessed at approximately 10% of total costs and, in general, satisfied members that the British Steel Corporation had the knowledge to deal with nearly all the known pollution problems from their operations.

C. R. Cresswell
Hon. Secretary

Obituary

Mr. Cyril Edward Holland, a member of the Society for very many years, died on 16th May at the age of 77. Mr. Holland was first on the Divisional Council in 1966 and was its Chairman in 1971/72.

NORTH WEST

Report for year ending 23rd June 1976

The Divisional activities during the year under review resumed the pattern of activities which were prevalent prior to reorganisation of Local Government.

After the Annual General Meeting of the North West Division held at the Pembroke Halls, Worsley, on Thursday, 12th June, members were given a talk on the Solid Smokeless Fuels Advisory Service who afterwards entertained members to luncheon.

The Divisional Council met on four occasions during the year in the months of September and October 1975, and March and May 1976.

At the first meeting in September, Mr C. Darley, Director of Environmental Housing and Health for Wirral M.D.C., was elected Chairman of the North West Division. Mr W. Shires, of Manweb, was elected Vice-Chairman of the Divisional Council.

The meetings during the year have been concerned with progress in the domestic field of pollution control and the need to provide a programme of activity which could embrace the whole membership of the Division.

As a result of this wish of the Divisional Council, a Programme Sub-committee was formed with the instructions from the Council to provide a programme of interest which would include all the Divisional membership.

During the year this Sub-committee, under the Chairmanship of Mr W. Shires, arranged two meetings for Divisional members, one at the Belgrade Hotel, Stockport, where members were addressed by Mr G. B. Scott, Deputy Chairman of N.W. Gas, and afterwards entertained to luncheon, and at the Gas Board Showrooms, Preston, where two papers were given by two very young men, Mr B. Manifold, M.Sc., who spoke on district heating, and Mr J. G. Pollitt, M.Sc., who spoke on lead in the environment. Both these meetings were well attended and enjoyed by members present.

Again assistance, advice, lectures, lecture notes have been given to schools, students and ladies' guilds during the year.

It is apparent that the general public, particularly students and schoolchildren, are becoming more aware of the environment and the way man pollutes it.

It is obvious that in another generation air pollution of the environment will be the concern of everyone and not just us few cranks!

The vigilance should not be relaxed; the need for control is required now more than ever. The shift of atmospheric pollution from smoke to chemical pollution is increasing rapidly each day as new technological processes are introduced into industry. There is a greater need today for the National Society for Clean Air than in 1929 when the Manchester Coal Smoke Abatement Society amalgamated to form the National Society.

W. E. Pollitt
Hon Secretary

A vital exhibition in a new setting

The third Environmental Pollution Control (ENPOCON) Exhibition will be held in the new National Exhibition Centre, Birmingham. It will cover all equipment, plant, products, services, systems and supplies associated with the fight against pollution—including pollution of land, air, sea and waterways. Main categories will be solid-waste pollution, air pollution, noise and vibration pollution, radiation pollution and sea and water-ways pollution.

Overseas Visitors

The last ENPOCON exhibition in 1973 attracted visitors from nearly every country in the world. The 1976 event will run concurrently with the Effluent and Water Treatment and with the Public Works Exhibition, each Exhibition having its own area in the NEC. This means that you will have the opportunity to visit both the Effluent and Water Treatment Exhibition and the largest Public Works Exhibition ever held in the UK as well as ENPOCON. *A worthwhile visit!*

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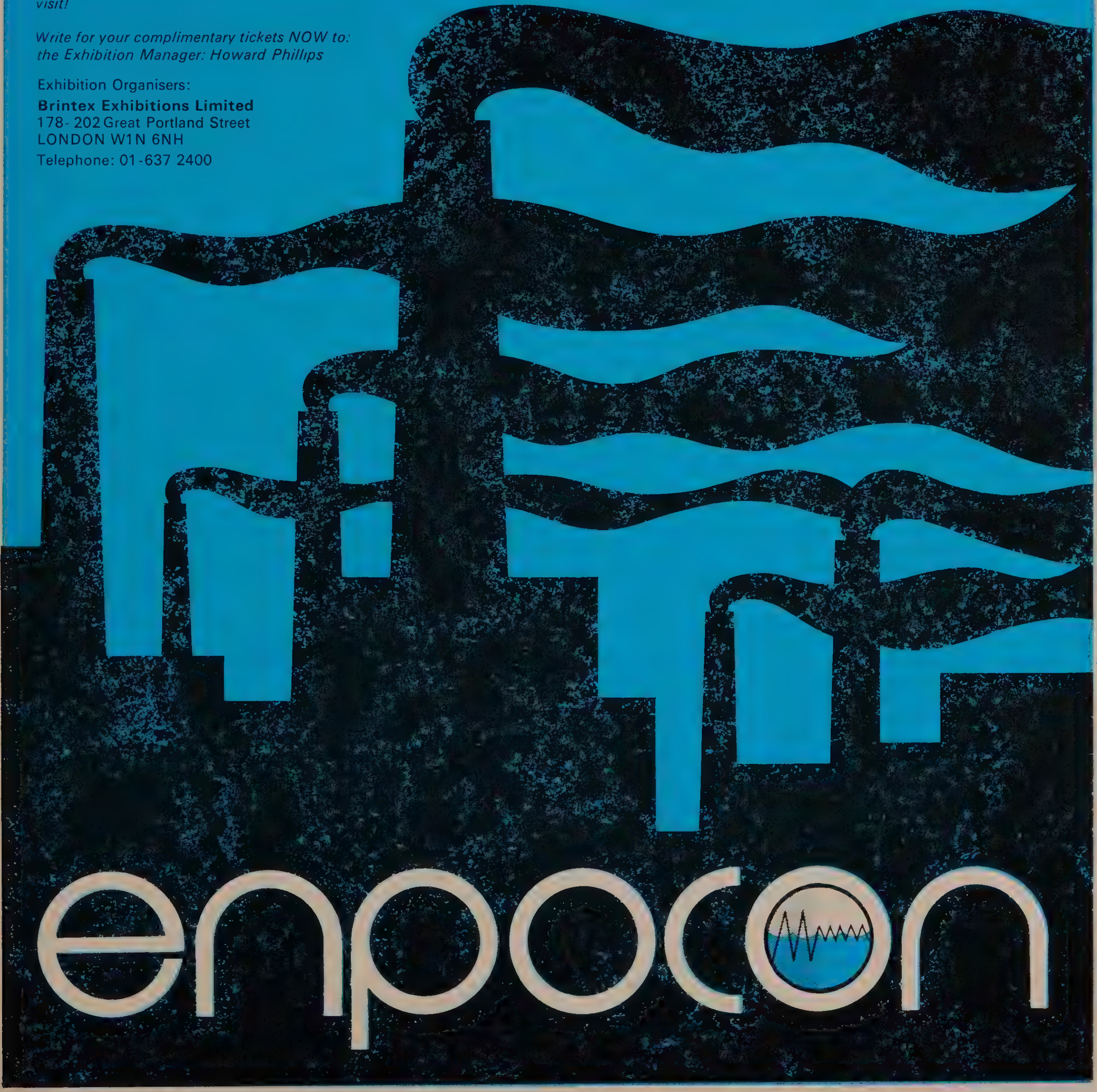

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Reader Enquiry Service No. **7652**

POLLUTION ABSTRACTS

40 Factors Influencing Plume Opacity. A. Weir and L. T. Papay, S. Calvert and S. C. Yung. Environmental Science and Technology, June 1976. Pp 539-544.

Numerous experiments on the removal of particulate matter with electrostatic precipitators have been conducted at the 1580 MW coal-fired Mohave Generating Station at South Point, Nev. It was established that opacity is not a function of particulate grain size loading alone, but is influenced by a number of other independent variables, some of which are beyond the control of the operator of the stationary source. The prediction of plume opacity by using light-scattering theory and measurements in the stack gas at Mohave were in agreement with observations made by trained observers. A parametric study of the effects of independent variables on plume opacity by using the same light-scattering theory shows that plume opacity can vary from 14-87%, depending only on the geographical location of the source and the time of day, with all other factors such as particulate matter emissions remaining the same. The relative effects of 24 variables on opacity are tabulated. There is an extremely wide variation in possible values of opacity, even when the mass emission of particulate matter remains unchanged. It is concluded that opacity measurements are not indicative of the mass emissions of particulate matter, and that mass emissions cannot be accurately determined from opacity observations. The use of an opacity standard to enforce a mass emission limitation is therefore difficult to justify on a technical basis.

Reader Enquiry Service No. **7653**

41 Fowls in Foul Air. John Burton. New Scientist, Vol. 71, No. 1014, 19th August 1976. Pp 400-401.

The article seeks to refute reports by other writers that birds are returning to London because the air is becoming cleaner. Mr. Burton devotes particular attention to observations and conclusions made by Stanley Cramp ('The Influence of Cleaner Air on the Breeding Birds of Inner London.' S. Cramp, pub. London Bird Report for 1973). Mr. Cramp had considered the large number of factors which may effect apparent changes in bird population, taking the House Martin as his example. His conclusion was that as other factors had not altered significantly, the only known new local factor, of lessened air pollution, may have led to an increase in the number of flying insects upon which the House Martin feeds. The present author does not dispute that this is a possible factor, but considers it both to be unproven, and only one of many equally plausible reasons for the return of birds to Central London. His argument is based on an analysis of the origins of insect population to be found in a city such as London. He proposes that direct correlation between bird species and availability of their food source does not hold when examination is made of the population fluctuations of a variety of species known in Central London. He also considers it unwise to attach undue significance to the date at which a species has colonised London, as factors other than suitability of habitat are also involved. Finally, Mr Burton notes that one of the few direct correlations between decreasing pollution levels and a return of wildlife has been provided for fish in the R. Thames by Alwynne Wheeler. The change in this case was suggested to be due to improvements in the oxygen level of the Thames, rather than to a greater abundance of food.

Reader Enquiry Service No. **7654**

42 A Study of Air Pollution in a North-West Town. Dr W. R. Bulcraig. J. Inst. of Fuel, June 1976. Pp 59-69.

Dr. Bulcraig is the group coordinator for environmental pollution at Pilkington in St. Helens, Merseyside. The paper reports a detailed survey made of air pollution in St. Helens, with particular reference to sulphur dioxide, and assessment of the extent to which the glass industry contributes to current levels of pollution, since St. Helens has one of the largest concentrations of glass works in the world. The levels of smoke and sulphur dioxide measured at National Survey sites are compared with national, regional and local levels. Smoke levels have fallen dramatically since 1957, and there has been a significant improvement in SO_2 levels. The present levels are similar to Greater London and considered tolerable. However, domestic coal-burning still makes the majority contribution to smoke levels, and it is expected that further improvements should result from continuous action by St Helens BC to introduce additional smoke control areas. A thorough analysis of the figures is made with regard to changes, trends and a comparison with levels in other North West industrial towns and rural areas. Pollution levels are correlated with meteorological levels, which cause wide variations in the measured daily mean levels. With the assistance of WSL, analysis is made of the contribution of domestic and industrial components to pollution levels. A model is presented showing the ground level concentration from all sources in the glass industry, compared with an assessment of the industrial component of the measured daily mean levels. Finally, consideration is given to the composition of the visible, and sometimes dense, plume characteristic of oil-fired glass works' furnace emissions.

Reader Enquiry Service No. **7655**

43 The Analysis of Airborne Sulphate. A critical review. R. L. Tanner and L. Newman. J. of APCA, August 1976. Pp 737-747.

This report reviews the current state of analytical methodology for sulphate in airborne particles. Methods for determination of total aerosol sulphate and total soluble sulphate are assessed. A more detailed review of the relatively new techniques for quantative speciation of airborne sulphate then follows. Size distribution methodology and filter sampling difficulties relating to the collection of airborne sulphate—containing particles are ennumerated. Experiments are suggested which use new improved, and potentially applicable sulphate speciation techniques to obtain a better understanding of the generation, transport, transformation and removal processes that, in turn, determine the identity and concentrations of sulphate species in ambient air.

Reader Enquiry Service No. **7656**

NEW ELECTRIC CAR FOR YEHUDI MENUHIN

On 8th September, the first Transformer 1 electric car to come to England was delivered to Yehudi Menuhin by Robert Aronson, President of Electric Fuel Propulson Corp. of Detroit, Michigan. The Transformer 1 is a luxury four-seater car, capable of a top speed of 70 m.p.h. Before arriving in London, the car was shown at the 4th International Electric Vehicle Symposium in Düsseldorf. From there it was driven by Mr Aronson to Zeebrugge, ferried to Dover and then driven to London—a total overland voyage exceeding 300 miles.

Mr. Menuhin, a member of the NSCA since 1964, bought the Transformer 1 for use in his daily activities around London. Driving a pollution-free car powered by electricity rather than petrol represents a contribution on his part to a cleaner environment not dependent on dwindling world supplies of petroleum.

The car's normal driving range varies from 50-100 miles per charge, depending on speed, terrain, number of stops and starts per mile and other factors affecting energy consumption. A special feature of the car is its Tri-Polar Lead Cobalt batteries which can be recharged to 80 per cent capacity in approximately 45 minutes with a fast charger. However, normally and probably 95 per cent of the time, charging would be carried out overnight at the owner's home using the car's on-board slow charger during the night with cheap off-peak electric power.

Two fast chargers have been developed by Electric Fuel Propulsion Corp. One is a stationary 50 kilowatt 'Charge Station' operating on 208-440 volts AC, 3-phase, which can be installed at petrol stations, hotels, shopping centres and other public places for the benefit of electric car owners who might occasionally require supplementary charging away from home.

The other is a 50 kilowatt 'Mobile Power Plant'. This was developed primarily for emergency highway recharging should an electric car equipped with lead cobalt batteries 'run out of juice'. The Mobile Power Plant (an engine-generator set on a two-wheel trailer) can be towed out for a quick charge on the spot, or can be hitched up to the electric car and switched on enabling the car to be driven straightaway, its batteries being rapidly charged by the Power Plant.

A secondary purpose of the Mobile Power Plant is to allow the electric car owner to take occasional long trips in the vehicle such as the one made by Transformer 1 from Düsseldorf to London.

Mr. Menuhin's Transformer 1 will be serviced in London by H. R. Owen Ltd, one of the world's largest Rolls-Royce distributors. Owen's managing director, John Leppard and Robert Aronson are working out a comprehensive service and recharging programme for Mr. Menuhin's car and for other Transformer 1's which may be purchased in London in the future.

The 'Brains' of the car are represented by a sophisticated electronic computer developed especially for the vehicle's 180 Volt battery/motor system. The device not only controls current and voltage but also monitors motor temperature and can be adjusted to provide various rates of vehicle accleration, according to the wishes of the driver. After searching the world for the supplier of such a device, Electric Fuel Propulsion Corp commissioned Cableform Ltd, Cheshire, England, to design the unit. After a year of engineering and testing, the 'Brain' was finally perfected and is now installed as original equipment in all Transformer 1 cars.

RSH LECTURE

The Environmental Planning and Building Group of the Royal Society of Health are arranging a meeting on Thursday 11th November 1976 at the RSH Headquarters. Dr. J. G. Firth, Deputy Director of the Occupational Medicine and Hygiene Laboratories, will lecture on 'The Work of the HSE Occupational Medicine and Hygiene Laboratories'. Admission is free but by ticket only. For application forms contact: RSH, Conference Dept., 13 Grosvenor Place, London SW1X 7EN. Tel: 01-235 9961. The closing date for application is 9th November.

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Telex: 95101
Telephone:
Forest Row 3777/8

Reader Enquiry Service No. **7657**

Change and Challenge in Dust Control Engineering

by

Peter Swift, B.Eng., C.Eng., F.I.Mech.E.

Consultant, Swift Technical Services Ltd.

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Introduction

Over the past twenty-five years the problem of atmospheric pollution within industry and from industry has steadily intruded into the life style of all industrial nations. From a relatively obscure problem, recognised by a few, albeit suffered by many, the problem has captured the interest and occasionally the sympathy of the media. With that peculiar facility for self-destruction and propensity for gloom, an essential adjunct of those Anglo-Saxon countries enjoying relative national affluence, the self-appointed pundits have immersed themselves, and the nation, to an unbelievable extent in prognostications of ecological disaster, the degradation of man's environment and the collapse of the socio-industrial systems that have served them so well.

To those individuals, and numerous they are, who are and have been involved in the solution of these problems, the current hysteria is neither helpful nor capable of commanding respect. One could observe that the more distant the commentator from involvement in the problem and hence commitment to its solution, the more facile his ability to pass judgment upon the situation before turning easily to the next burning issue of social injustice, the rectification of which usually depends upon continuing and significant increases in production and productivity, with their associated increase in the very problems so dear to the hearts of those who must do good.

Pollution exists in many forms, both of material and the mind. Air pollution was amongst the first to attract national interest: after all it was the easiest to see. Equally it is a field which has been subject to legislation for a long time, going back to the first Alkali Acts in the late 19th century in the United Kingdom. But as far as atmospheric pollution was concerned, it can be argued that the UK Clean Air Act of 1956 proved to be the great catalyst for a more widespread involvement of industry in the problem and its solution. This in turn stimulated and affected the thinking of dust control within factories. It is interesting, therefore, and may even provide a basis for optimism, to reflect upon the thinking and change in attitude, and abilities that have developed in the dust control field, particularly over the past 25 years.

Beginnings

The UK dust control industry has been particularly fragmented. Many hundreds of firms are engaged in that field, a considerable number of them through their services to the wood-working industry. In fact it can be argued that this industry provided the original need that started the dust control services as they are today. Wood-working machines produce such volumes of wood waste, chips, sawdust and sander dust, that their removal from the machine as they were produced was an essential requirement for the continued operation of the machines, irrespective of any social needs such as hygiene and comfortable working atmospheres. And fifty years ago, the needs of the former exercised more influence than the obligations of the latter. The contemporaneous removal of wood waste was achieved by the entrainment of the waste throughout purpose-designed hoods through a plenum system to a paddle-bladed fan blowing into large diameter cyclones, where the bulk of the waste was discharged from the bottom of the cyclone cone while the air and fine dust escaped to atmosphere through the cyclone thimble. Such systems required a high degree of sheet metal working ability but were within the capabilities of the average sheet metal working firm to design and manufacture. Much thought and skill were devoted to the design of the hoods for the machines, hoods carefully sited to catch the chips as they were thrown at speed from the cutters, and connections which catered for the many varied cutter movements and configurations. The ducting systems were examples of craftsmanship at its best, and many examples of their galvanised sheet steel duct work are giving good service years after installation.

These wood waste collection systems were a splendid example of the right application of the right resources to solve a particular problem. Hoods, ducting, inspection doors, cyclones with open bottom waste discharge and paddle-bladed fans were all relatively simple items requiring simple tooling within the reach of virtually the smallest sheet metal worker. Service to the consumer was an essential requisite for success and since site erection was always involved, the close proximity of sheet metal workers to their source of business was a major ingredient in providing good service, in which speed of completion was often an unavoidable stipulation. This close proximity provided an easy and ready personal contact between suppliers and users, which, in turn, reduced the paper work content of the job, both commercial and technical, usually to the benefit of both parties concerned.

Those now involved with problems dealing with dust, perhaps fine particles would be a better description, could be mistaken in thinking that wood waste control and collection presented no real problem in concept or design. Wood chips were so large. But those experienced in the field, whilst admitting that their problems may not call for any great degree of intellectual ability, were very much aware of the many opportunities to be disagreeably surprised by the unexpected behaviour of wood waste, either as individual chips or in collected form when the plants were put in operation. As always, there was no substitute for experience. On reflection, those hundreds of sheet metal workers had a commercial existence that is the envy of many today. They were their own masters, often taking sons into the business. They worked with their hands and were in no way remote from the job. They had direct personal contact with the user and could see their finished plants in operation. They thrived on low overheads, had the finest of labour relations (they worked for themselves), immediate proximity to their sources of business, the simplest administration, a mixture of hand working in the shop, visits to sites and inside and outside working; they were the industrial equivalent of a farmer, their feet on the ground, their minds tuned to reality, their job satisfaction self-evident and their involvement complete.

But like most things, time brings changes, some call it progress.

Most industrial processes create dust incidentally, but none the less a nuisance, if allowed to disperse within the working environment. Allied with a growing degree of social introspection and environmental awareness, the increased articulation of the working man, with his discovery of power to improve his conditions through improved union organisation, insisted on better working conditions than had hitherto been considered either possible or commercially supportable. But where there is a will, there is a way: Society willed the means and technology found the way.

This situation called for the development and application of fine dust control technology on a wide scale. The position in the UK was, in many ways, curious. Relatively few of the many sheet metal firms operating primarily in the wood waste control field had developed into larger units equipped with greater and more sophisticated commercial skill, but still essentially operating with a simple technology. In fact, it could be argued that the most advanced technology was provided by UK firms working as agents of foreign manufacturers, predominantly American, with German and Swedish manufacturers coming a poor second. Few indigenous manufacturers developed their own dust control technology, with particular reference to the collector. In this context, these comments apply to cyclones, wet washers and fabric filters. Electrostatic precipitators were a field on their own, with a large number of new coal-fired power stations providing ample opportunity for business. So it was that in the early 1950s very few UK dust control manufacturers really understood the principles governing the performance of their collectors. One major firm, for example, blandly confirmed that the pressure loss through all their fabric filters at all times was 1 inch water gauge. Education in this matter came from the more sophisticated users, such as the chemical industry, who applied their customary discipline to establishing and defining the parameters of function and performance. I doubt very much whether their services to industry as a whole by that work have ever been fully recognised.

Many other users regrettably displayed an even greater ignorance than the suppliers. Again about this time one major user, a world leader in the technology of his own specialisation, was heard to order, "Six of those wet boxes," which were, in fact, six self-induced spray wet dedusters. As to grade efficiency curves, inlet dust concentration, inlet size distribution, effluent concentration, size distribution and plume obscuration or ease and frequency of maintenance, these matters were not for conscious deliberation. It was a time, in fact, when the knowledge of the supplier, inadequate as it was, was significantly better than that of the user. You can imagine that on many occasions this situation resulted in the user not getting the standard of service and performance to which he might be entitled in this best of all possible worlds.

But as has been said, the Clean Air Act provided an enormous impetus to better understanding of dust control, particularly on the part of the user. In fact, 15 years later, in many instances the state of knowledge outlined above has been completely reversed. The user is much more informed than the supplier, an achievement worthy of respect and brought about by a combination of many forms of education and enlightenment, from seminars to workshops, universities to company libraries, industrial research centres, government establishments, the more easy inter-country exchange or meeting of staff, and, of course, efforts on the part of the dust control industry itself. In fact, I would venture to suggest that the return on expenditure for dust control equipment is very much greater now, allowing for inflation, than was the case 20 years ago. Much of this is due to competition, but equally much is due to the greater understanding of the subject by the users. This point of better value for money is conveniently demonstrated by the development in design and application of fabrics filters.

Fabric filters

Fabric filters have many advantages compared with other collectors, not least they present a capability for giving 100% collection efficiency and, other than a possible degree of aggregation, do not change the state of the material collected. Yet 25 years ago, the fabric filter was overshadowed by the cyclone and wet washer. To some extent this was due to the limitations in application imposed by the fabric filter designs then available, as well as acceptance of the lower capital cost of the cyclone and wet washer even though it meant tolerating a lower collection efficiency. For a satisfactory fabric filter installation two conditions must be satisfied.

1. The intrinsic design of filter must be sound.
2. The application of the filter to the problem must be right in type, size, filter media material, and consonant with the operational and maintenance ability of the user.

In these days of catalogued filter designs and ranges it is difficult to believe that in the early 1950s, some dust control companies did not believe a standardised range of filters was a commercially viable proposition: rather each filter must be custom-designed and built for each order! Surely a classical example of an industry underestimating its own potential market. In those days many filters for nuisance dust control were simply open tubular bags fitted to a bottom spigot plate. Cleaning was achieved by manually beating the filter bags with a stick. Obviously fans were placed upstream from the filter which had to operate above atmospheric pressure. Hence simple fans were used, capable of handling the dust, with a consequence that fan efficiencies of the order of 50% were usual. Gradually it became accepted that filters could be designed as a range, with the advantages of standardisation, that fans should be sited after the filter, handle only cleaned air and hence allow more advanced blade design with efficiencies of 80%, and that filters operating below atmospheric pressure would fail/safe as far as the immediate environment was concerned.

At the same time the methods of cleaning filters were subject to intensive development. A large measure of recognition must go to those who pioneered and developed the high pressure reverse jet filters using felted fabric media. This truly was the significant development of fabric filtration in our lifetime. These designs gave so many advantages and now give so much scope for further development.

Normal woven fabric filters require mechanical agitation for cleaning with or without associated low pressure reverse air. This mechanical agitation imposes restriction on fabric selection, in so far as the fabric must have the mechanical strength to withstand the stress and wear imposed by mechanical agitation. Again the mechanical components required to effect such bag cleaning are somewhat heavy and cumbersome. High pressure reverse air jet systems with their small bore piping and valves are much more convenient mechanically.

Even more important is the fact that high pressure reverse jet cleaning allows the use of felted media, because mechanical agitation is not now required, and you could not shake felted filter bags very well. In spite of its appearance, felted materials are more permeable to air flow than woven materials. They can, therefore, filter more air per unit fabric area for a given resistance and their collection efficiency is better.

Now many firms offer this type of filter and the refinement of design now taking place is encouraging. Compactness in design is always desirable, provided it is not carried to the point where it detracts from performance or prevents good access for inspection and maintenance. Equipment operating in the hostile environment of air and dust should also be simple in design, and simplicity, an essential precursor of reliability, is often the first virtue that eludes the designer. Yet there are filters available demonstrating such simplicity with thoroughness and precision. Again there are some interesting variations on the geometry of reverse air flow in relation to the air flow within the filter element. Other well-known firms also offer filters using reverse air flow and felt filter elements.

Unit filters

Of particular interest are the unit filter developments that have occurred using this form of filter cleaning. Attention is focused so often on the large installations that the enormous number of small unitised applications are overlooked. This type of filter reflects a different concept of approach in application but not in function. The idea is to apply small filters to individual points requiring dust control. Often they can be so integrated with the dust producing process that the dust collected can be returned directly to the system, so avoiding all the cost and inconvenience of handling the collected dust as an operation separate from the original process served. And in any case unitisation avoids the cost and inconvenience of centralised ducting systems, allows filters to be operated only when their associated process requires it, gives flexibility of machine layout and can be deployed easily as and when needed.

Costs

As standards and scope of dust control have risen, the cost involved has become at times formidable. In fact, even on a unit basis, the cost of a filter unit can exceed the cost of the machine for which it has been purchased. This may be surprising but consider how often today one finds that the postage on a Christmas parcel is as much as the cost of the contents. In the case of dust control this situation reflects the cost comparisons between batch production in sheet metal work and semi-mass production in cast and machined components, and the higher sales cost in a somewhat esoteric industry compared with machine tools, for example.

Nevertheless it can be a salutary experience to examine the simple components of a bag filter as delivered before assembly on site. Sheet metal items, punched, notched and folded, angle iron sections, simple hoppers, spigot plates, filter bags, small horsepower motors for shaker gears, all in total are difficult to relate to the purchase price, as it is to relate 20% or more of the contract price to erection, particularly when the customer's own labour force often appears to do most of the work. Some dust control companies make good profits but many make mediocre to poor profits. Apparently high prices for products cannot be always attributed to high profits and it may be more to the point to consider the general pattern of overheads in the industry.

Dust control seems particularly vulnerable to the boom-recession cycle, and the periods of higher business activity are dealt with by a substantial degree of subcontracting. In many cases this prevents the development of an efficient production system for piece parts or the acquisition of production machinery of the latest design which can help so much in cutting costs. Nor can it be claimed that filters are designed, with few exceptions, to facilitate economical production. It also is a matter of speculation whether in these days of production shortages there is any incentive for the more efficient firms to use their efficiency and scale of production to undercut the average market price for comparable products. To paraphrase Parkinson, do overheads expand to absorb the market price available?

Of great effect, however, are the procedures adopted for securing business and establishing the type and size of equipment involved for a particular application. Accurate figures are very difficult to come by but a reasonably sized firm in dust control probably receives one order for every five quoted: this ratio need not apply to the values of quotations made. However, even on a numerical basis a ratio of this order is expensive, involving as it does individual visits, scheme drawings, detailed estimating, specifications and quotations, not to mention numerous modifications to content and price as the user-supplier relationship and understanding develops.

Equally expensive is the rectification of application errors, particularly where the collector is concerned. Selling dust control is not like selling a kilo of apples, a precise weight of a specified product. There are no absolute standards in dust control and any new factor affecting a process, such as speed, size, different combination of operations or change in product, for example, can materially affect the equipment required or the effect anticipated.

Perhaps the Dust Control Industry is less than fair to itself, in so far as its procedures for evaluating the equipment required before quotations seem so varied in both approach and thoroughness of examination. Of course, such pre-quotation work is expensive and may not result in business—the competition may adopt a much more sanguine view of both the problem and the ability of their equipment to solve it, but surely it is in the interests of both users and suppliers to co-operate in establishing, as far as possible, a uniform and defined approach to the parameters affecting the selection of equipment to give the desired performance.

The points to be classified may be enumerated thus:

Performance

1. Air entrainment capacity, m^3/hr.
2. Degree of collection efficiency, %.
3. Intermittent or continuous operation.
4. Dust burden to be handled, mg/m^3.
5. Average effluent discharged, mg/m^3.
6. Collected dust discharge arrangement (intermittent or contemporaneous).
7. Services required, compressed air, water, power.
8. Collector resistance to air flow, cm water.
9. Maintenance requirements and procedures.
10. Temperature limitations.
11. pH limitations.
12. Hygroscopic effect capabilities.

Dust

1. Density absolute.
2. Density bulk.
3. Dust burden.
4. Size distribution.
5. Shape factor.
6. Free flow ability.
7. Angle of repose.
8. Acid or alkaline.
9. Temperature.
10. Moisture content.
11. Hygroscopicity.
12. Hardness.
13. Toxicity.
14. Explosion capability.

Now it is not often that all these questions can be answered, at least without a lot of effort. In the very big installations such effort is easier to justify but enquiries of smaller value make such an investment in pre-sale time and effort difficult. Of course, past experience can provide probable answers, and enable reliable assessments to be made, but surely it would help if there was some consistency of approach to this problem, with a more open relationship between user and supplier. The more there is an agreed definition of the problem, the less opportunity there is for error and disappointment. This involves effort on the part of the user as well as the supplier. There seems, for example, or there certainly has been, ambiguity about the true air volumes required for air-swept grinding mills. Accurate information on such a matter is essential if effective and economical dust control is to be provided.

Efficiency claims

The vexed question of permissible filtration velocities well illustrates this plea. For given dusts of roughly comparable size analysis and concentrations would one not expect comparable filtration velocities from different manufacturers? After all, dust is dust and felt is felt. But this is not so: some firms can apparently filter at twice the velocity of others. I find it difficult to believe that such varying filtration velocities can be achieved for the same application. Cleaning systems can vary in effectiveness but that should not significantly affect the filtration velocity. My reaction some time ago to the query of a chemical engineer involved in the operation of dryers, as to which cloths were used to give the differing filtration velocities he had been quoted, all with guaranteed collection efficiencies, was that at best the differing filtration velocities quoted reflected the competitive pressures upon the firms concerned, their lack of knowledge on the subject at worst, rather than a unique property of a particular filter cloth unknown to all but the firm quoting the high filtration velocity. One answer to this confusion is the wider acceptance of the benefits to be gained by more plant testing carried out sometime after installation to establish the true conditions of plant operation and performance gained, and the open dissemination of these results.

Notwithstanding these comments, I think the dust control industry is now adopting a more methodical and factual approach to its problems, both in design and application. Certainly there is more consideration of the needs of the user including the need for easier maintenance and less of it, easy access and inspection, fewer moving parts, more standardisation, and avoidance of the need for any work by human beings within the dirty side of the collector, a recognition, in fact, that a customer has the job of running and maintaining a dust collection plant for years after the contractor has left the site and that in 10 years there can be a revolution in working conditions tolerated by organised labour.

Certainly there has been a lot of empirical development over the past 25 years. Improvements in the next 25 years will, I think, require far more work of a fundamental nature, on the mechanics of gas-borne particle fabric filtration. We can often predict the result of the application of existing filters but our true understanding of, and hence our ability to improve, the process of filtration and cleaning is less sure. The rectification of this position will require much effort and probably yield no quick or easy return. The fragmented nature of the dust control industry will not help it in this future task, and clearly, extensive co-operation with organs of more formal and academic learning will be necessary. But the work must be done. As Dr Barnes Wallis would say: "Why not?"

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Reader Enquiry Service No. **7658**

INDUSTRIAL NEWS

Statutory Labelling Scheme for Dangerous Chemicals Proposed

Some 800 dangerous chemicals commonly used in industry, about a dozen of them also used in the home, are covered by a statutory labelling scheme proposed in July by the Health and Safety Commission.

The proposed labels, which would cover such dangerous chemicals as strychnine, sodium cyanide and benzene, include easily understood pictorial warnings of the hazard presented by the chemicals. The proposed scheme would be a great advance in safety as it would for the first time make it a legal obligation for many of these dangerous chemicals to carry a warning of the danger they present.

The scheme is issued in the form of draft regulations made jointly by the Secretary of State for Employment and, to take into account protection of home users, the Secretary of State for Prices and Consumer Protection. The proposals have been sent for comment to the TUC and the CBI, consumer organisations and trade associations. The consultative period terminated at the end of August and the Commission have asked the Secretaries of State for Employment and Prices and Consumer Protection to introduce legislation by July 1977 which would require suppliers to attach warning labels to containers of all these chemicals.

The most dangerous chemicals are classified either as explosive, highly flammable, toxic or corrosive. Others, while still dangerous, present a lesser hazard and are classified as oxidising, flammable, irritant or harmful.

The main feature of the label is a danger symbol accompanied by a key word. Each symbol shows the likely dangers and will be printed in black on a bright orange/yellow background so that it stands out prominently. Each danger category has its own symbol: an exploding bomb for explosive substances; a flame over a circle for oxidising substances; a flame for highly flammable substances; a skull and cross bones for toxic substances; a picture of a hand and a piece of metal being dissolved for corrosive substances and a St. Andrews Cross for harmful or irritant substances.

In addition the label will carry:

— one or more risk phrases spelling out in more detail the main dangers, e.g. "causes severe burns" or "reacts very violently with water";

— one or more safety phrases may also be carried giving advice on sensible safety precautions e.g. "wear suitable gloves" or "never add water to this product";

— the name of the chemical and the name of the supplier or manufacturer to help doctors or first aid staff in the event of an accident.

In addition to labelling, the draft regulations propose that packaging must be designed and constructed so as to prevent accidental spillage in the normal course of handling.

The Commission proposes that the responsibility for attaching the label should lie with suppliers. Manufacturers or importers will be required to attach labels before supplying directly to other manufacturers or before supplying wholesale or retail outlets. Wholesalers or retailers will still have an obligation to ensure that products are properly labelled before selling them to users; but in practice the Commission expects that they will leave on the manufacturers' label. Wholesalers or retailers who re-package will have to attach their own label. Minimum sizes are specified for the label but there will still be room for manufacturers to put brand names and other information elsewhere on the container.

Containers of some dangerous chemicals already have to be labelled for international and domestic transport and for storage. For these chemicals a composite label would be allowed so that a container need carry only one label.

Health and Safety Inspectors (e.g. Factory Inspectors) will be responsible for enforcing the regulations to ensure that manufacturers, importers and wholesalers attach the proper label on containers of dangerous chemicals no matter to whom they are being supplied. They will also be on the look-out, when inspecting factories and other workplaces for containers of chemicals which have not been correctly labelled. Weights and Measures inspectors will be responsible for enforcing the regulations as they apply to sales from shops.

The labels have been devised by the European Economic Communities and all nine member states have agreed to introduce the scheme. Germany, France and Belgium already have it partially in operation.

Reader Enquiry Service No. **7659**

Head Wrightson Plant Reduces Air Pollution

99 per cent of the iron ore sinter dust from the Normanby Park Sinter Plant which at present escapes to the atmosphere will be collected by a new pollution control unit being commissioned by Head Wrightson Process Engineering Limited London Division at the BSC's Scunthorpe Works.

The horizontal flow, dry plate precipitator installed at the sinter plant will also ensure cleaner internal working conditions for employees as dust escape points have been covered by intake hoods which collect the dust for transport along the numerous gas mains leading to the precipitator.

Head Wrightson Process Engineering Limited London Division are supplying the system which operates through the dust particles being electrically charged by high voltage wires between vertically hung flat steel plates forming the gas ducts. The charged dry dust migrates to these collector plates from where it is dislodged into a hopper for disposal. This precipitator will treat 200,000 actual cubic feet of dust laden air per minute using 72,000 sq feet of collector plates.

Commissioning of the unit will be followed by two other very large pollution control units which the London Division expects to commission this year. These installations include four electrostatic precipitators for the British Steel Corporation at Ravenscraig, Scotland, and a very large fabric filter plant for the Guest Keen & Nettlefold Group at Cardiff.

Reader Enquiry Service No. **7660**

Bus drives home "Save It" theme

One of the North East's biggest bus companies has lent the weight of a 77 seater double deck bus to the Government's campaign to conserve energy resources.

Northern, the Gateshead-based NBC subsidiary, has repainted one of its buses with a series of bold posters aimed at persuading motorists to go by bus and "save it". The campaign promotes the idea that every bus seat occupied by a motorist means one less car on the road consuming fuel.

Northern's traffic manager, Brian Hirst, said that public transport was in a position to make an important contribution to fuel conservation.

"Last year Northern carried in the order of 158 million passengers. We are hoping to encourage more people back on to the buses by making them a more attractive alternative to private transport—especially in the case of peak hour users in towns and cities—through the improvement of our services.

"If our campaign is successful, not only will this help save fuel, but it will reduce road congestion enabling buses to move more freely through urban areas.

"Obviously there are few better ways of getting our message across to the public than by making use of our own vehicles as mobile poster sites."

Reader Enquiry Service No. **7661**

Noise Control at Leeds Infirmary

A total energy unit now under construction as part of the new General Infirmary and Medical and Dental Schools at Leeds will not create noise problems—thanks to a £16,000 contract just completed by Industrial Acoustics Company.

IAC engineers have installed a noise control system based on standard Noishield Louvres and Acoustic Doors. Built into three exterior walls of the energy plant in both single and back-to-back louvre configurations, the Noishield Louvres will take in fresh air for the cooling tower intake system and at the same time attenuate the noise created by the cooling towers. The louvres are capable of handling 566,000 lts./sec. at maximum resistance of 60N/m^2 and demountable bird screens have been fitted to the back of each louvre.

Made from heavy-duty galvanised steel, the Noishield Louvres are based on a standard IAC modular design. They provide a weather and noise shield and comply fully with architectural standards of appearance. This is certainly the case at the generating station complex where the louvres provide the major focal point to the South West elevation in scale with the 20m high walls.

Reader Enquiry Service No. 7662

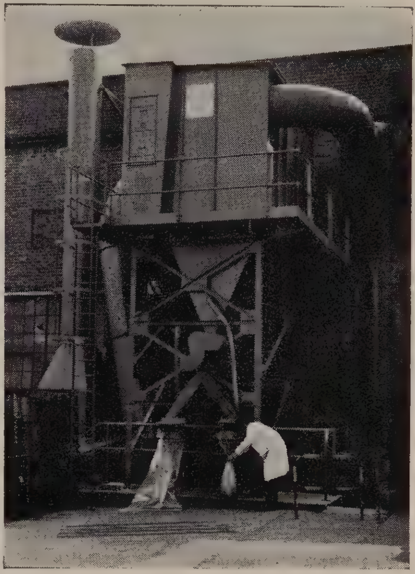
Safe handling of asbestos

The effective control of the dust emanating from, for example, a grinding or machining operation, depends on creating a uniform airflow to draw the dust into ducting which will remove it from the workplace. The design and positioning of the collector hood is an important factor in determining the effectiveness of the dust control system, but no less important is the uniformity of the airflow. Where possibly hazardous materials such as asbestos are being machined, it is even more important to ensure that all the dust is removed from the workplace, to avoid the possibility of it being inhaled by the work force.

Ferodo Ltd have manufactured friction products since before the turn of the century, and the majority of products use compounds containing asbestos. Dust control equipment has been in use since long before the present legislation was introduced, and the latest system to be installed has been selected to maximise the efficiency of removal of asbestos dust from the work place, and its subsequent safe collection.

Ferodo have installed an Aeronca International 'Dynaclone' continuous dust filter to collect particles of asbestos, resins, fillers and compounds containing asbestos from an air stream extracted from a workshop engaged on the grinding of friction products. The collected dust is bagged for safe disposal.

The 'Dynaclone' filter treats 15,000 cubic feet of air per minute, removing 99·985 per cent of particles down to ½ micron in size, discharging the cleaned air via a sound attenuator to atmosphere.



Safe dust control conditions are maintained at the workplace by the constant exhaust rate provided by the 'Dynaclone'. An inherent low pressure reverse air flow constantly purges collected dust from the filter media, thus preventing a dust build up, and if necessary the filter can be operated 24 hours a day seven days a week, without break.

The dust falls into hoppers at the base of the filter, from which it is continuously removed by a screw conveyor. An Aeronca 'Rota-Val' rotary valve prevents ingress of air to the system, which is operating under suction.

A feature of the 'Dynaclone' filter is the design of the filter media. This is constructed in the form of flat bags, allowing a given area of filter cloth to be contained in a smaller space than with alternative arrangements.

The 'Dynaclone', which is designed on a modular basis, was delivered to the site fully assembled. As well as the filter itself, Aeronca also designed and supplied the sound attenuator on the exhaust.

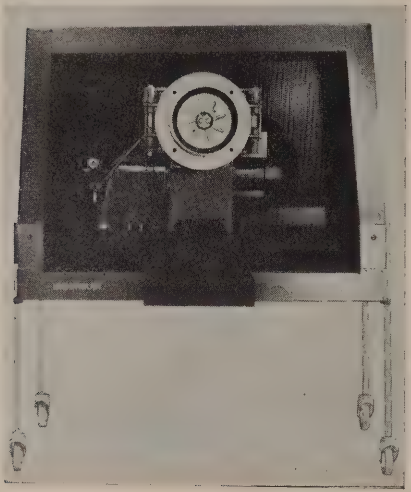
Preventing the ingress of rainwater, which could irreparably affect the working of the filter, is of particular importance with an outdoor installation such as this. Ferodo say that their experience of the unit has shown the design to be particularly good in this respect.

Reader Enquiry Service No. **7663**

New Range of Sound Absorbers for Combustion Burners

To reduce noise levels in heating installations, industrial process plant, and wherever combustion burners are used, a new range of sound absorbers has been introduced by Weishaupt (U.K.) Ltd.

Designated type WA2, all four models offer good absorption characteristics over the audible frequency range, typical overall noise reduction being 62 per cent.



Unlike most other sound absorbers on the U.K. market, which are offered as custom-built units, all Weishaupt absorbers are standard products. The four WA2 models are of the totally enclosed type, dimensions varying from 72 × 48 × 60cm. to 127 × 93 × 99cm.

Cabinets are mounted on four adjustable legs, enabling the unit to be raised and lowered according to the vertical position of the burner. 50 cm. extensions are available to raise the unit, if required, to accommodate burners mounted in high positions. The design also enables the absorber to be used on installations where the clearance between the floor and burner casing is small.

Castors are fitted to the legs for easy removal of the absorber when carrying out burner maintenance, and a single bracket fixes the absorber to the burner and holds it in position.

All WA2 sound absorbers are suitable for use with the Weishaupt Monarch burner range, as well as many other makes and models.

Reader Enquiry Service No. **7664**

New Thermix High Energy Venturi Scrubber

Newell Dunford Engineering Ltd., the Dunford & Elliott Company, have now introduced the Thermix High Energy Venturi Scrubber to extend further their existing wet dust collection line. This follows an intensive period of development and testing of full size operational plants.

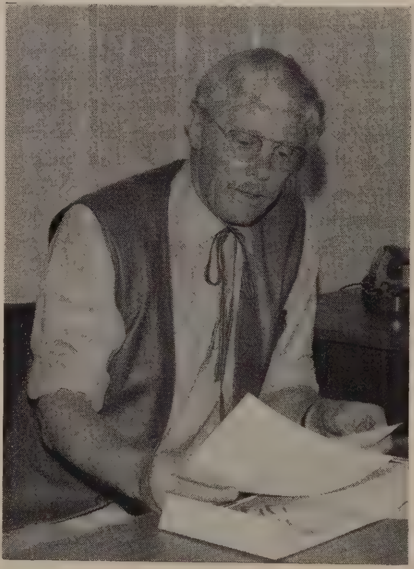
In the Venturi Scrubber the water is fed to the gas stream through a wetted approach convergent section leading to the throat. This overcomes a dry/wet interface and possible build-up problems. The high degree of turbulence at the throat causes the gas to become totally saturated with water. The gas then flows to the divergent section of the vent carrying with it, as a very fine spray, the excess of ‘ over-saturation ’ water that was fed to it. As the velocity decreases in this section, the pressure increases and condensation of vapour occurs. This rapid condensation takes place on the dust particles in the gas which act as nuclei. Dust particles thus wetted, agglomerate readily and are collected in a low energy centrifugal mist separator.

Selected pressure drop is dependent on the application to suit emission standards, but range generally between 10in. and 50in. w.g. Large gas volumes of virtually any capacity can be accommodated. A throat plug provides a variable throat orifice for duty modifications.

Reader Enquiry Service No. **7665**

Swedish Consultant for Nailsea Dust Control

Nailsea Engineering Co. Ltd. have retained the services of Mr Sture Asklof as Consultant for the application of dust control within the iron and steel industries. Mr Asklof is already well known in the United Kingdom for his activities in the mineralogy field, more particularly with regard to the dust-free operation of quarries through the use of encapsulated plant.



A native of Malmo, Sweden, Mr Asklof has been concerned with the development of new plant—both in foundries and quarries—throughout Europe, North Africa and the United States. Since 1959 he has been Chief Consultant with Demister AB, of Malmo, and his paper on total process encapsulation (given in England, May 1975) is a standard reference on the subject. Most recently he has acted as consultant on dust control for the NJA steel works at Lulea in North Sweden.

Reader Enquiry Service No. **7666**

Portable Instrument to Measure Airborne Dust Levels

Immediate determination of respirable dust particle levels in a mining or other industrial work environment is now possible with a lightweight, portable instrument that provides direct digital readout of dust concentrations in seconds.

Battery operated, weighing six pounds and equipped with a shoulder strap for easy transport, the solid state RDM-101 respirable dust monitor being marketed in the U.K. by Carboeglen can be carried anywhere for real-time monitoring of concentrations of respirable dust particles.

Direct digital readout of mass concentrations in milligrams per cubic meter range is obtained directly following a short-term sampling interval of the order of minutes. Different sensitivity ranges from the factory preset range can be obtained by adjustment of the sampling time.

In operation, the instrument uses an indirect method to “weigh” dust by measuring the amount of radiation from a 100 microcurie beta source which is absorbed by dust particles collected on an impactor stage. The rechargeable batteries permit, for example, 200, 60-second measurements during a typical eight hour work shift. Readying the instrument for a subsequent measurement period requires only battery charging and simple replacement or cleaning of the impactor disc.

Reader Enquiry Service No. **7667**

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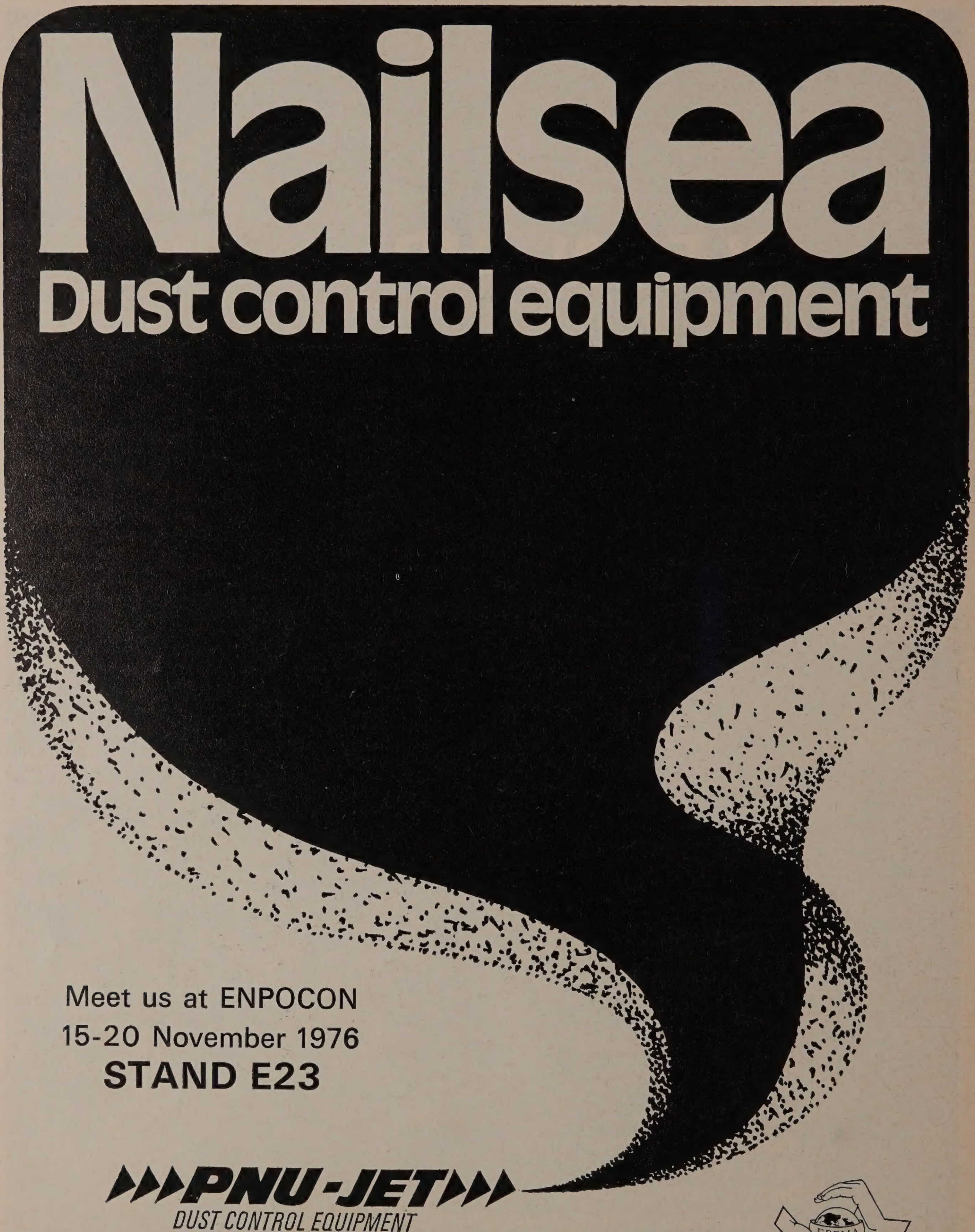

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